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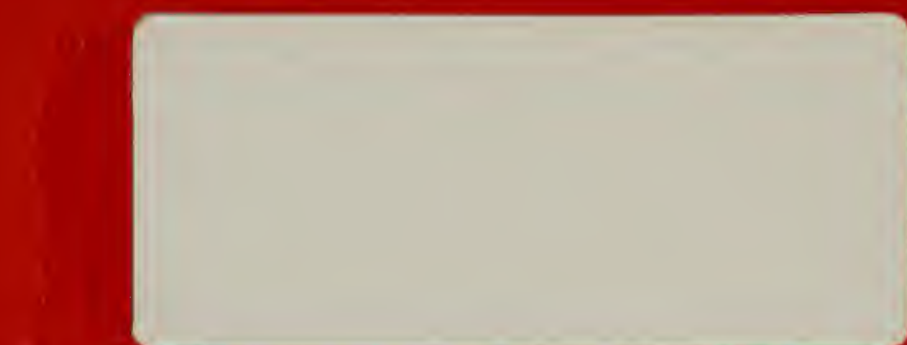


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LOWER WOLF CREEK
WATERSHED MANAGEMENT PLAN

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LOWER WOLF CREEK
WATERSHED MANAGEMENT PLAN

May 198⁴~~7~~

Craig District
White River Resource Area
Meeker, Colorado

LOWER WOLF CREEK
WATERSHED MANAGEMENT PLAN

May 198~~7~~⁸

Craig District
White River Resource Area
Meeker, Colorado

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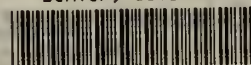
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TABLE OF CONTENTS

| | PAGE |
|--|------|
| I. General Overview of the Watershed Problems | 1 |
| A. WMP Summary | 1 |
| B. Introduction | 1 |
| C. Location | 2 |
| D. Historical Background | 2 |
| E. Purpose and Need | 5 |
| II. Objectives and Recommendations | 6 |
| A. Objective | 6 |
| B. Benefits | 7 |
| C. Comparison Studies | 8 |
| III. Description of Watershed Components | 8 |
| A. Climate | 8 |
| B. Topography | 9 |
| C. Geology | 9 |
| D. Minerals | 9 |
| 1. Coal | 9 |
| 2. Locatable | 12 |
| 3. Salable Minerals | 12 |
| E. Oil and Gas | 12 |
| F. Soils | 12 |
| 1. Introduction | 12 |
| 2. Description of Major Soil Groups | 13 |
| 3. Soil Moisture | 16 |
| 4. Soil Erosion | 16 |
| 5. Sediment Yield | 17 |
| G. Hydrology | 18 |
| 1. Surface Water | 18 |
| 2. Groundwater | 18 |
| 3. Water Quality | 19 |
| 4. Drainage Features | 20 |
| 5. Water Rights | 20 |
| 6. Existing Watershed Projects | 20 |
| H. Vegetation | 23 |
| 1. Introduction | 23 |
| 2. Threatened/Endangered, Rare and Sensitive Plants and Remnant Vegetation Associations | 26 |
| I. Wildlife | 26 |
| 1. Terrestrial | 26 |
| a. Big Game | 26 |
| b. Sage Grouse | 27 |
| c. Raptor | 27 |
| 2. Threatened & Endangered Species | 27 |
| J. Livestock | 28 |
| K. Cultural Resources | 28 |
| L. Aesthetics/Visual Resources | 29 |
| M. Recreational Resources | 29 |
| N. Wilderness Resources | 29 |
| O. Social and Economic Values | 29 |

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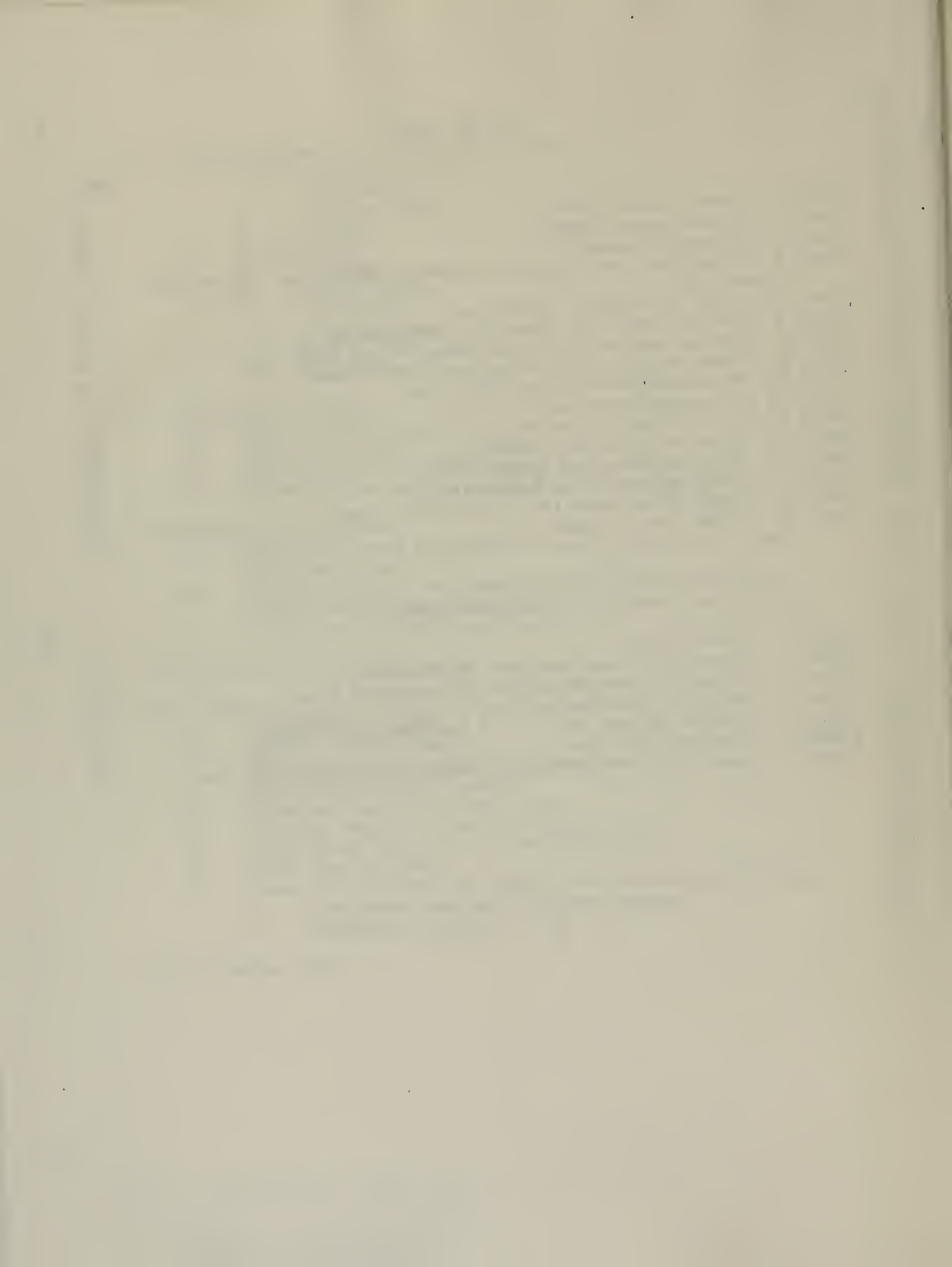
| | PAGE |
|--|------|
| IV. Project Implementation - Planned Action | 30 |
| A. Preliminary Strategies | 30 |
| 1. Introduction | 30 |
| 2. Treatment Units | 30 |
| 3. Ranking | 33 |
| B. Alternatives | 34 |
| 1. No Action | 35 |
| 2. Minimal Action | 35 |
| 3. Low Action | 35 |
| 4. Moderate Action | 35 |
| 5. High Action | 37 |
| C. Cost Estimates | 37 |
| V. Feasibility Analysis | 37 |
| A. Salinity Guidance | 39 |
| B. Types of Controls | 39 |
| C. Determining Cost Effectiveness | 40 |
| D. Methods of Estimating Direct Runoff from Rainfall | 42 |
| VI. Monitoring and Studies | 42 |
| A. Measuring Inputs and Outputs from the Lower Wolf Creek Watershed Area | 42 |
| B. Possible Studies for Determining the Effectiveness of Various Projects on Reducing Both Sediment and Salinity Yields in the Treatment Areas | 44 |
| VII. Consultation and Coordination | 47 |
| VIII. Appendices | 48 |
| A. Legend to Map Overlay | 49 |
| B. Geologic Column Summary | 50 |
| C. Soil Occurring in Lower Wolf Creek | 53 |
| D. Water Resource Data Summary | 57 |
| E. Existing Watershed Project List | 58 |
| F. Existing Vegetation Manipulations | 61 |
| G. Range Sites Occurring in Lower Wolf Creek | 62 |
| H. Plant Species Names | 63 |
| I. Types of Structures and Vegetation Manipulations Planned | 64 |
| 1. Management and Land Treatment Measures | 64 |
| 2. Structural Measures | 66 |
| IX. References Cited | 68 |

LIST OF TABLES

| | PAGE |
|--|------|
| Table 1 - Public Water Rights | 21 |
| Table 2 - Private Water Rights | 22 |
| Table 3 - Allotment Summary | 28 |
| Table 4 - Prescribed Structures for Treatment Units under the Various Alternatives | 34 |
| Table 5 - Array of Project Alternatives | 36 |
| Table 6 - Cost Estimates for Vegetation Manipulation | 37 |
| Table 7 - Sample Construction Project Benefit Cost Data | 38 |
| Table 8 - Proposed Monitoring at Various Funding Levels | 43 |
| Table 9 - Possible Watershed Structure Sizes | 45 |
| Table 10 - Livestock Permittees | 47 |
| Table 11 - Soils Occurring in Lower Wolf Creek | 53 |
| Table 12 - Water Resource Data Summary | 57 |
| Table 13 - Existing Watershed Projects List | 58 |
| Table 14 - Existing Vegetation Manipulations | 61 |
| Table 15 - Range Sites Occurring in Lower Wolf Creek | 62 |
| Table 16 - Plant Species Names | 63 |

LIST OF FIGURES

| | |
|--|----|
| Figure 1 - Vicinity Map | 3 |
| Figure 2 - Lower Wolf Creek Watershed Location Map | 4 |
| Figure 3 - Geology Map for NE Portion of Lower Wolf Creek | 10 |
| Figure 4 - Geologic Cross Section From Elk Springs Quad | 11 |
| Figure 5 - Typical Pattern of Soils in Treatment Unit 1 and 2 | 14 |
| Figure 6 - Treatment Unit Map | 31 |
| Figure 7 - Lower Wolf Creek Watershed Monitoring Site Location Map | 46 |



LOWER WOLF CREEK WATERSHED MANAGEMENT PLAN

I. General Overview of the Watershed Problems

A. Watershed Management Plan Summary

The White River Resource Area has written a plan and associated environmental assessment to improve water quality. This will be done through salinity control, by reducing runoff, and soil erosion, improving vegetation cover and the watershed's ability to retain precipitation. The plan covers about 120 square miles of Mancos Shale, in northwest Colorado, characterized by erodible saline soils and a fragile ecosystem.

The Lower Wolf Creek watershed has been divided into five treatment units to implement the plan's objectives. Treatment units are based on land forms and potential vegetation for determination of the appropriateness for water retention structures and/or vegetation manipulations. Tables are included on types of structures and vegetation manipulations planned for each treatment unit, cost estimates, and feasibility analyses.

Extensive discussion is included on the general overview of watershed problems, description of watershed components, objectives, and recommendations of the plan and project implementation. Five alternatives are provided, ranging from heavy emphasis on vegetation treatments, to relying on engineered structures to achieve the goals of the plan. Four funding levels from \$10,000 to \$500,000 are included in the Array of Project Alternatives table to indicate how future funds will be spent.

B. Introduction

This watershed management plan (WMP) was developed primary to improve water quality principally with regard to salinity control and reduce soil erosion by improving vegetation cover and reduced runoff. The final reduction in sediment yield would, however, be limited by dominating factors such as climate, geology, topography, etc., which control the development of the landscape. This WMP should allow vegetation to recover in many places of the watershed and provide greater livestock and wildlife forage availability.

Soil erosion is an ongoing process affected by many factors, including past and present land use, existing geology, and regional climate. The geologic parent material often determines the general nature of a watershed. The soft shales of sedimentary rocks and harsh climate of the Lower Wolf Creek Watershed, coupled with frequently intense thunderstorms, rapid snowmelt, and long dry periods, produce a distinctive and fragile land form characteristic of a semi-arid environment. This land form is very susceptible to erosion, which has resulted in a drop of the base level of the drainage network. This in turn has thus, accelerated gully development and hindered the natural reestablishment of grasses.

The onset of gullies was accelerated during the period of unregulated grazing at the beginning of this century. The problem of unregulated grazing was alleviated when livestock numbers were reduced as a result of the Taylor Grazing Act. Subsequent intensive management of grazing permits through implementation of the White River Resource Area Grazing EIS has also helped.

The need for this WMP was identified in the soil and water resources section of the MFP for the White River Resource Area (WRRRA). Only a small portion of the watershed is covered by an existing allotment management plan. The LWC WMP will be incorporated into the future RMP scheduled to be written for this area.

C. Location

The Lower Wolf Creek watershed is located in Rio Blanco and Moffat counties in northwestern Colorado and is approximately 20 miles northeast of the town of Rangely (Figure 1). The WMP area is located approximately 66 miles west of Craig, Colorado and lies adjacent to U.S. Highway 40. To the west 3 miles is Massadona, Colorado and it is 20 miles east of the Dinosaur National Monument headquarters. This WMP is in a remote area and is a great distance from large population centers, but many tourists pass through here each season.

The Lower Wolf Creek Watershed Planning Area covers 123 square miles (78,720 acres), or approximately 58 percent of the entire Wolf Creek drainage (214 square miles, 136,960 acres). This includes 4,480 acres of Colorado State land and 9,245 acres of privately owned land; the remainder is managed by the BLM (64,995 acres).

Wolf Creek is a tributary to the White River, which is a major subbasin of the Colorado River System. The main tributaries to Wolf Creek are Coal Creek, East Fork Wolf Creek, Middle Fork Wolf Creek, and Divide Creek (Figure 2).

The base map (at 1:50,000 scale) and overlays for geology, soil mapping units, soil erosion potentials, treatment units, range allotments and improvements (existing projects), and stream orders are available at the White River Resource Area Office (see Appendix A for overlay contents). Due to the size of the maps, they are not included in this document.

D. Historical Background

Highway 40 is the main route from Craig to Salt Lake City. The old Wells Fargo stage line followed this approximate route and at one time had a station at Massadona. All property owned by them has been sold.

The Civilian Conservation Corps (CCC) built a 200 man camp at Massadona in 1938. This camp was in existence until the outbreak of World War II in 1942. The projects completed by this group included: road construction, reservoirs, spring developments, stock trail posting,

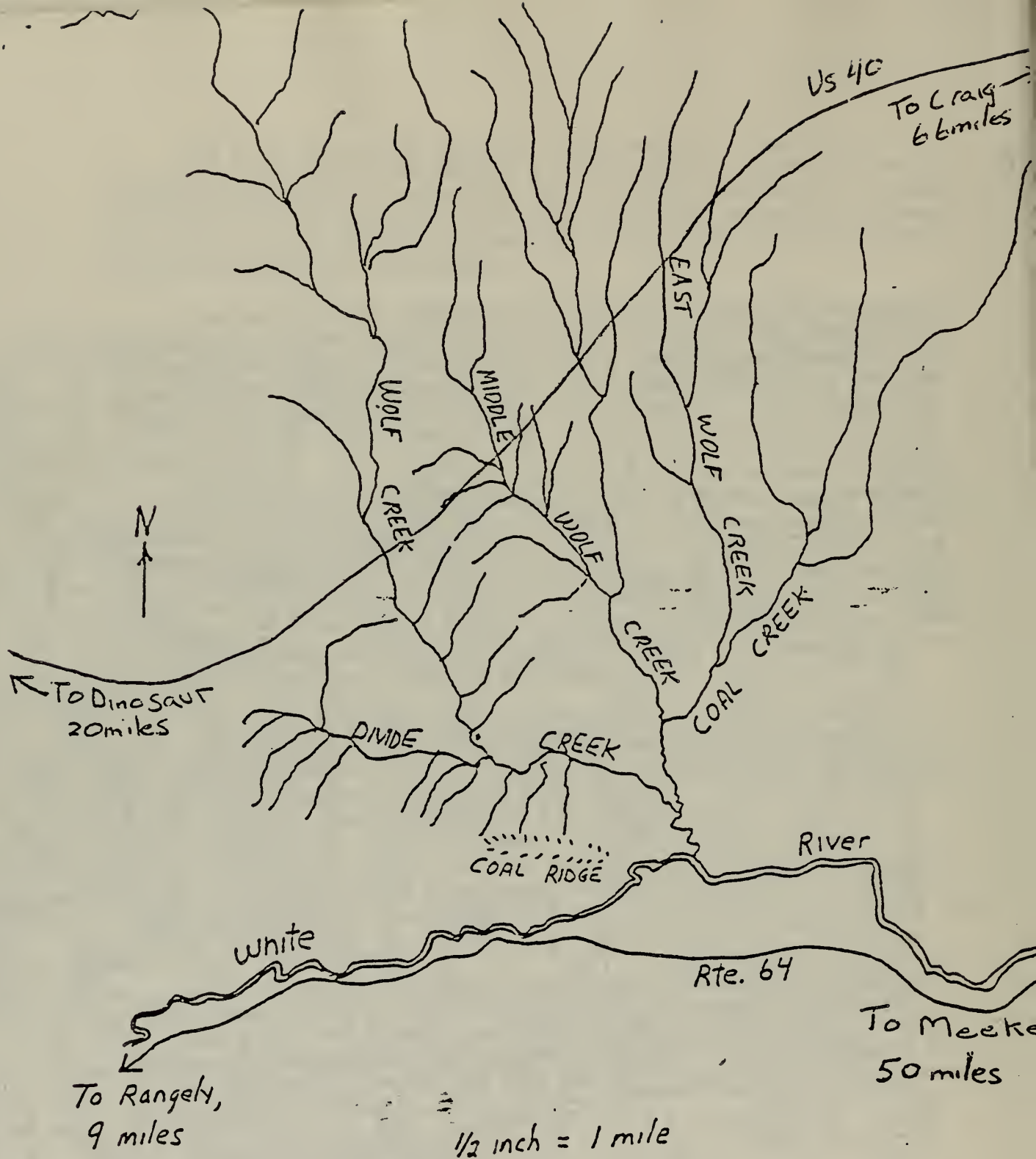


Figure 2 Lower Wolf Creek Watershed
Location Map

and fencing. Many of the fine accomplishments are still in existence today. The camp itself has been removed except for a few buildings.

In 1964, the Divide Creek tributary was classified as a Resource Conservation Area (RCA). The purpose of the RCA was to demonstrate various practices and land treatment measures in improving forage conditions and reducing runoff, thereby increasing grazing capacity and decreasing erosion and sedimentation. Another major purpose was to provide roadside stops along U.S. #40 and to provide limited recreation for the public. This site was chosen for two reasons. First, the area was used very heavily by the cattlemen as a winter range. After they went out of business the sheepmen moved in and overgrazed it. This overgrazing coupled with intense thunderstorms, typical of desert ecosystems, has accelerated the erosion rates on this area (USDI, BLM 1964). Secondly, the work that has been completed in this RCA was a good starting place to demonstrate the effectiveness of the various conservation practices. Maintenance was needed on existing projects and would be done at the same time new work was being done. Contour furrowing, check dams, spreader dikes, and seedings were recommended by the RCA to reduce erosion and improve the range for livestock and wildlife use.

E. Purpose and Need

Implementation of this watershed management plan will aid watershed stabilization and salinity reduction to benefit the BLM multiple-use program. The primary goal will be a sustained yield of cleaner water, a decrease in soil loss, and an increase in vegetation cover.

Issues associated with this area are generally of two types: onsite and downstream. Onsite issues involve decreasing soil erosion by increasing the soil stability and vegetation cover. Downstream issues involve salinity and sedimentation in the Colorado River System.

Onsite losses include lowered soil productivity (which may take centuries to rebuild) and effective vegetation cover, which is required for soil stabilization. In its present condition, the watershed is incapable of providing the quality and extent of habitat necessary for sustaining target populations of wildlife. This unrealized habitat potential could be translated as a loss of recreational hunter use.

Downstream losses include; 1) limited or reduced water use for irrigation and recreation, 2) lowered quality of aquatic habitat, 3) salinity problems, and 4) sedimentation in the lower Colorado River System.

The Bureau of Reclamation (USDI 1983) reports the major instream uses in the Colorado River basin include hydroelectric power, propagation of fish and aquatic life, recreation (including swimming, waterskiing, boating, rafting, etc.), and aesthetics. All of these uses are curtailed by excessively saline and/or turbid water.

The sediments from erosion have been flushed from the watershed and deposited primarily in the reservoirs on the Colorado River System. With the completion of the Taylor Draw Reservoir on the White River near Rangely, a large portion of the future sediment loss will be deposited in the reservoir, shortening the dam's life span.

Mineral salts derived from the Mancos Shale Formation are flushed out with the sediment. Unlike the sediment, the salts are not deposited in a reservoir, but are transported downstream to the sea or diverted with irrigation water. Problems arise for crops sensitive to saline conditions when mineral salts are left behind in the fields after the irrigation water has evaporated.

II. Objectives and Recommendations

A. Objectives

1. Prevent permanent reduction of natural site productivity because of soil loss.
2. Reduce or prevent economic loss due to erosion onsite and sediment damages downstream.
3. Increase vegetation cover for watershed stability.
4. Reduce salinity and improve water quality.
5. Provide better flood control downstream by lowering flood peaks and runoff velocities.
6. Reduce or prevent impairment and improve the aquatic and riparian area habitats.

These objectives will be accomplished by using the following treatments and recommendations.

- a) The maintenance program will lengthen the life span of structures which have become silted in but are still important for maintaining watershed stability.
- b) Construction of new reservoirs will be planned in areas still actively eroding. Construction will also be used where old reservoirs have failed and it would be cheaper to build new structures than repair the old ones. These engineered structures will be designed to reduce the peak flows from severe rains in order to decrease erosive forces in the channels and gullies. They will also provide the multiple benefit of watering facilities for improved distribution of livestock grazing.
- c) Vegetation manipulations such as burning and spraying combined with land treatments such as contour furrows will be planned on bottom lands and gently sloping uplands presently dominated by invader plant species. The goal of these manipulations will be to increase water infiltration, vegetation vigor and production.

This will reduce the cutting action from infrequent rains and snowmelt that results in overland flow. Immediate reseeding will take place to favor native perennial vegetation, and grazing will be deferred on these sites for a minimum of two growing seasons.

- d) Seeding of native grasses and forbs will be done on all construction sites and critical sites susceptible to direct flows. Fertilizing and mulching will be recommended as site specific needs are identified for rapid establishment of perennial vegetation.
- e) Roads will be maintained where active erosion is evident using waterbars, ditches, and crowning.
- f) In conjunction with the range management of each allotment, fencing may be proposed to reduce pressure on overgrazed sites, thus providing better distribution through deferment.
- g) ORV usage should be controlled through district policy. Interpretive signs could be posted to inform the watershed users of the possible damage to plants and soils.
- h). Big game numbers and use could be moderated through license issuing procedures, that is, recommending the Colorado Division of Wildlife that licenses be increased in problem game management units. Rodent and rabbit control could be effected through publicity efforts aimed at concentrating small game hunting and harvest in problem areas.

B. Benefits

This Watershed Management Plan will provide multiple-use benefits in addition to the primary purpose of achieving cleaner water and decreased soil loss. Original benefits to water quality are reduced sediment yield and salinity control. Decreased sediment yield into the main rivers will lengthen the usable life of large reservoirs and improve the downstream aquatic habitat. Reduced salt loading to the Colorado River System would be a direct benefit to major downstream users, primarily to irrigators in the Southwest.

Projects proposed for salinity control on BLM lands will also provide benefit opportunities to other watershed activities and grazing management. Specific benefits will be quantified, when possible, during project design. Vegetation will respond through implementation of vegetation manipulations and other treatments and as soil and watershed stability improves. Other multiple benefits include increased water sources for livestock and wildlife, enhanced forage production, improved wildlife habitat, and better flood control. Increased usage by hunters and recreationists, who could easily get to this area from U.S. Highway 40, may also result.

Areas having the highest salt and sediment yields will have low potential for improvements in range condition. Because most of the watershed improvements will be paid for with BLM soil, water and air

funds, or possibly from special salinity control funds, the control of salt and sediment will be the primary objective. In most cases the benefits derived from the control of salts, will outweigh the other benefits which might be obtained. However an effort will be made to coordinate watershed management/salinity control activities with allotment management plans. Coordination will be necessary to assure that multiple use aspects can be maximized whenever possible.

C. Comparison Studies

Many studies have been done by Federal Government agencies and Universities on the relationship between land use, erosion, and salinity control. (See Section IX, References Cited, for a list of publications for further information concerning watershed research on saline soils.

Hawkins, et al (1977) report many conclusions on erosion and runoff control and vegetative management with respect to salinity and sediment control. The BLM (USDI 1978) states, disturbance of soils including upland and channel erosion is considered to be the major source of salt from overland runoff. Li Simons and Associates (1982) studied the effects of trampling by livestock on infiltration rates, runoff sediment production and salt content of surface runoff from Mancos Shale-derived soils. Lusby (1978) reported on the Badger Wash study relating livestock management to sediment yield and runoff.

III. Description of the Watershed Components

A. Climate

The WMP area is located in a semi-arid, continental climate regime characterized by dry air, sunny days, clear nights, low annual precipitation, extreme evaporation, and large diurnal temperature changes. The complex topography of the region results in moderate variations in site-specific temperature, precipitation and wind intensity and patterns. The greatest variations in snow distribution occur along the watershed perimeter to the north, south, and east, where large ridges are present.

Severe weather conditions such as tornadoes, damaging hail, and severe flooding are rare. However, intense short duration summer thundershowers frequent the watershed. Effective precipitation is decreased, due to the clayey soils which generate runoff from the Mancos ridges in the center of the watershed.

Daily average temperatures vary very little over the watershed. Generally, summer temperatures range from lows of 45°F (6°C) to highs of 85°F (30°C). Winter temperatures generally range from 5°F (-15°C) to 35°F (2°C). Extreme temperatures may fall as low as -40°F (-40°C) or climb up to 100°F (38°C). Frost-free periods vary from year to year but tend to range from 60 to 150 days (SCS 1982).

Annual precipitation in the watershed is highly variable with changes in elevation, ranging from 7 to 14 inches (18 cm to 35 cm). The average annual precipitation for the WMP area is approximately 9

inches. In 1981, a raingage was installed two miles south of Elk Springs in the northeast corner of the WMP area. The limited amount of data at this site for the 1982 and 1983 water years shows a precipitation range from 16 to 23 inches per year. This larger than normal amount of precipitation was due to an extremely moist year in 1982. The elevation rise at Pinyon Ridge results in a substantially higher annual precipitation compared to the center of the WMP area.

Slightly more than half of the annual precipitation comes from scattered spring and late summer thunderstorms. Snowfall amounts vary (averaging 36 inches), and snow is commonly redistributed by wind. The limited data indicates that evaporation far exceeds precipitation, with the driest conditions occurring in mid-summer.

B. Topography

The Lower Wolf Creek watershed consists of broad plateaus, steep escarpments, rolling hills, rough canyonlands, and gently sloping valleys. Elevations range from a low of 5,460 feet (mean sea level) at the mouth of Wolf Creek to a high of 7,277 feet in the extreme northeastern portion of the watershed along Elk Springs Ridge.

The lower watershed is bordered on the west by the Skull Creek Rim and on the south by Coal Ridge. The eastern and northern borders are formed by Pinyon Ridge and Elk Springs Ridge, respectively. Slopes throughout the watershed tend to be steep to very steep near the borders and flatten out gradually toward the central portion of the basin. The aspect of the basin is predominately to the south.

C. Geology

Rock exposed in the Lower Wolf Creek watershed ranges from Pennsylvanian to Cretaceous in age. Large amounts of Tertiary and Quaternary unconsolidated and poorly consolidated sediments are also found in the area. Approximately 75 percent of the lower watershed is made up of Mancos Shale or sediments deposited by weathering of Mancos Shale. See Appendix B for a summarization of the stratigraphic column. See Figure 3 for the geologic map of the northeast quarter of the Lower Wolf Creek watershed and Figure 4 for the associated cross section.

D. Minerals

1. Coal

The northeast portion of the Lower Wolf Creek watershed (WMP) area is located in the Lower White River Known Recoverable Coal Resource Area (KRCRA), therefore this area has potential for coal development. There are currently no coal leases within the Lower Wolf Creek watershed area.

The coal in this area is found in three coal zones of the Cretaceous Mesaverde Group. There is a thin economically unimportant lower zone near the base of the Iles Formation, a middle zone containing beds as thick as 11 feet at the base of the

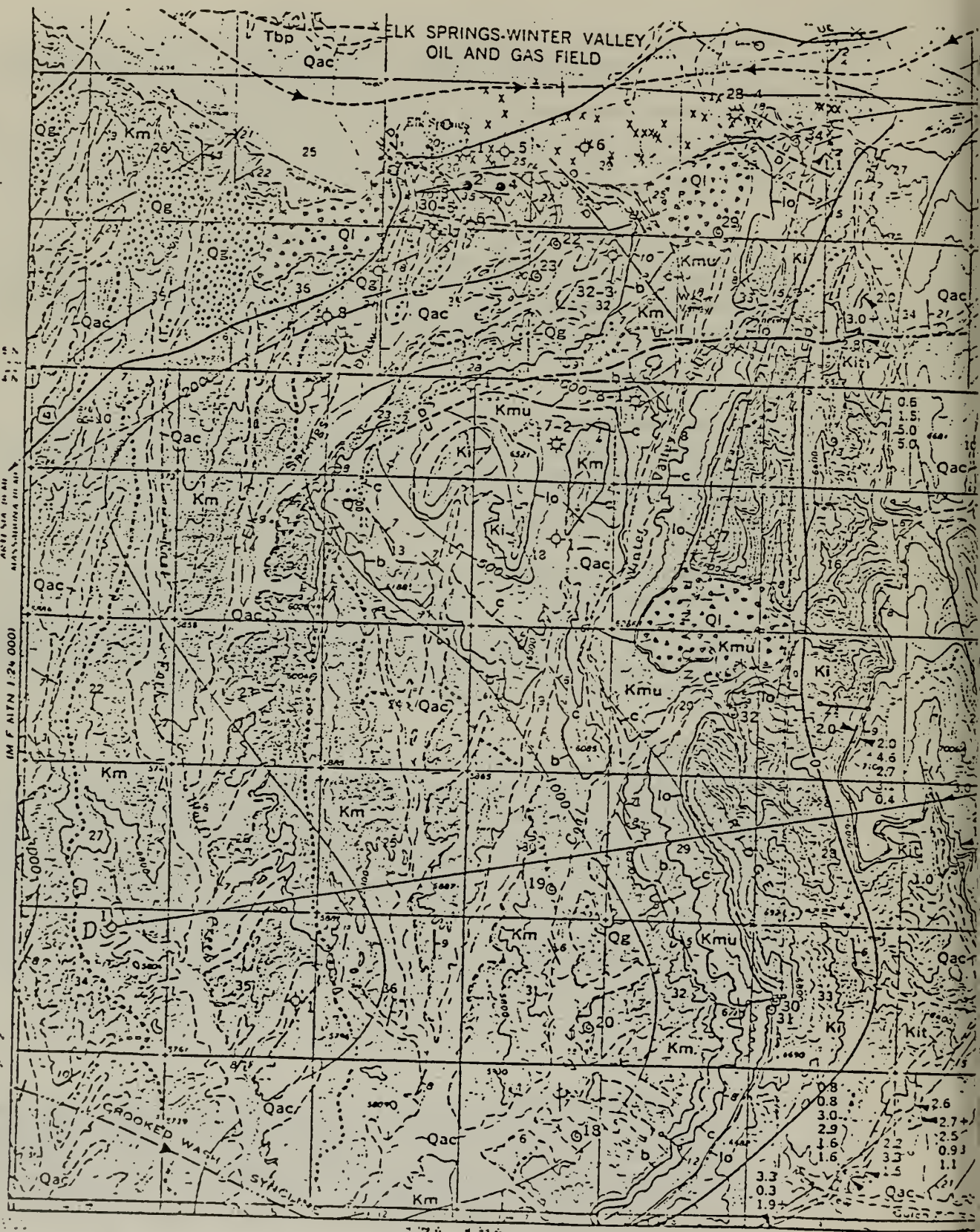


Figure 3 - Geology Map for NE Portion of Lower Wolf Creek

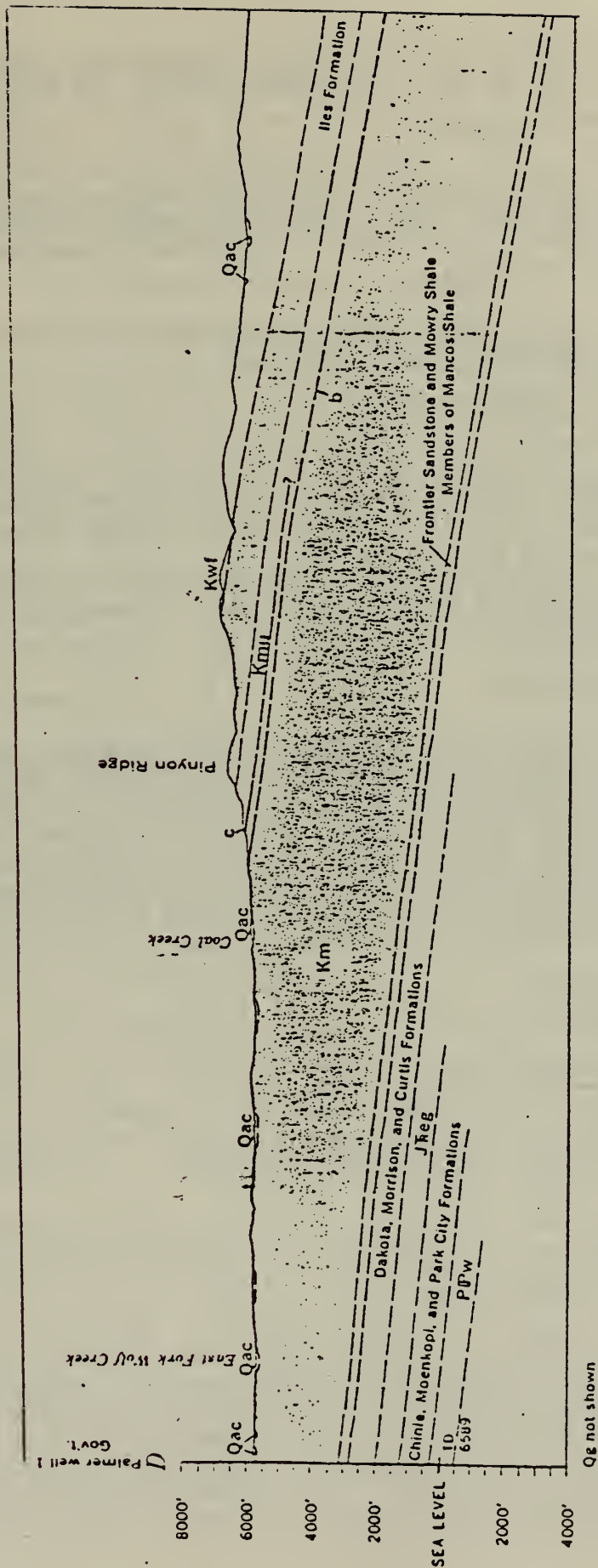


Figure 4 - Geologic Cross Section From Elk Springs Quad

Williams Fork Formation, and an upper zone containing beds as thick as 10 feet in the upper half of the Williams Fork Formation.

2. Locatable

There are 73 mining claims located around the perimeter of the WMP area. These claims are probably located for uranium that is found in the upper white crossbedded sandstones of the Brown's Park Formation.

Given the current market value for uranium, these claims will probably not be developed.

3. Salable Minerals

This area has many fulluvium, alluvium, and colluvium deposits of sand and gravel and other sandstone material used for building and maintaining roads in the WMP area.

The development of the WMP would not significantly affect the amount of material that could be used for road building and maintenance in the future.

E. Oil and Gas

All of the property with oil and gas reserved for the Federal Government (approximately 80-85% of the WMP area) has been leased for oil and gas development or has leases pending. To date, most of the development which has occurred, includes five producing wells in the vicinity of Elk Springs. This is due to the presence of a known geologic structure (KGS) within portions of the following legal description. (For more exact descriptions refer to the Oil and Gas section of the White River URA Step III.)

Township 4 North, Range 98 West, 6th P.M.
Section 12

Township 4 North, Range 99 West, 6th P.M.
Sections 7, 8, 17, and 18

Township 5 North, Range 98 West, 6th P.M.
Sections 21, and 28-32

F. Soils

1. Introduction

The soil resources within the WMP area are extremely variable, depending on parent materials, elevation, slope, aspect, past climate and time in place. The soils in the area have been mapped by two Soil Conservation Service (SCS) Order III soil surveys. The southernmost portion of the watershed is within the Rio Blanco County Soil Survey Area; complete detailed maps and mapping unit descriptions are found in the published survey (SCS

1982). The remainder (northern portion) of the watershed is located in the Moffat County Soil Survey Area. Complete maps and mapping unit descriptions are found in the unpublished Moffat County Soil Survey Manuscript (SCS 1983). The detailed maps and descriptions are available from the SCS and are on file at the Craig District and White River Resource Area offices. The list of soil mapping units occurring in the watershed is in Appendix C.

2. Description of Major Soil Groups

The information in this section has been summarized from data received from the SCS in the form of Rio Blanco County and Moffat County Soil Surveys and Soil Interpretation forms (Form 5's). The following descriptions are for the five major soil groups (Treatment Units) that have a distinctive pattern of soil characteristics, relief, vegetation cover, and drainage. Each land type has a unique natural landscape. The soils making up one unit can occur in other soil units but are located in a different pattern. Those broad areas can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the detailed survey maps and from field investigations. The typical pattern for the soils in Treatment Units 1 and 2 is shown in Figure 5. See Section IV, Project Implementation for an explanation of the treatment units.

Mancos Uplands - (Treatment Unit 1). These soils occur on low hills, ridges, and toe slopes in the center of the watershed. They are shallow to moderately deep (10 to 40 inches deep) and well drained; have a low available water holding capacity, and are gently sloping to steep. These soils formed in-place on gypsiferous Mancos Shale and are fine textured. They are moderately to strongly affected by salt and alkali, containing approximately three percent salt by weight. In some areas these soils are severely eroded.

The vegetation on this mapping unit is mainly salt-tolerant desert shrubs and sparse grasses.

The main limitations include shallow depth to bedrock, a high erosion hazard, slow permeability, and a high shrink-swell potential.

Mancos Alluvium - (Treatment Units 2). These soils occur along the major drainages and side tributaries on nearly level to gently sloping sites. They are generally of recent deposition and show few diagnostic horizons. They formed in mixed alluvium from shale and sandstone. The soils are deep (at least 60 inches thick) and well drained. The alluvium from shale is fine textured and generally calcareous throughout. They are slightly to moderately affected by salt and alkali. The alluvium derived from sandstone is stratified medium to coarse textured and can have rock fragments throughout the profile.

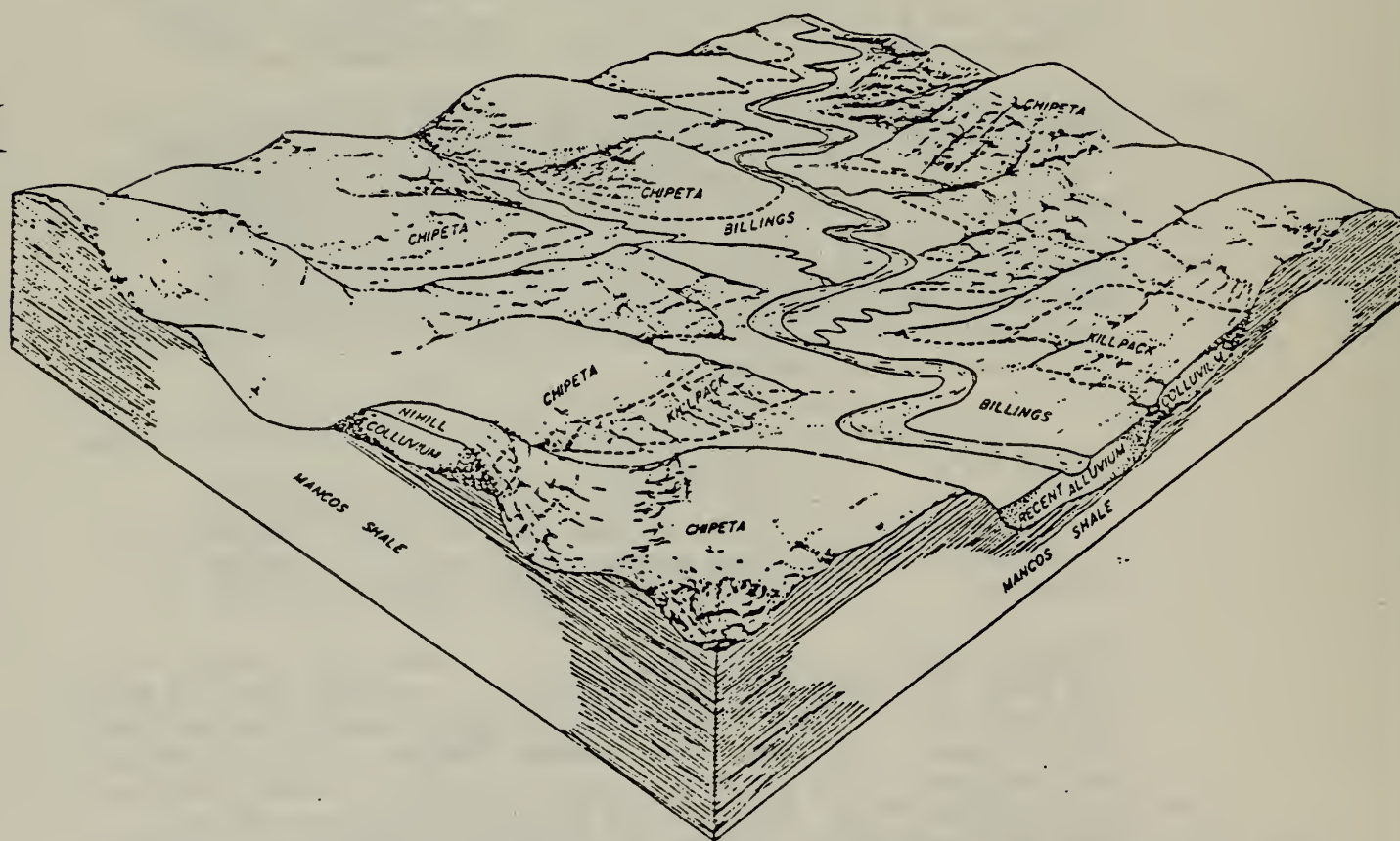


Figure 5 Typical pattern of soils in treatment units 1 and 2
 Chipeta and Killpack mapping unit equals T.U.1
 Billings mapping unit equals T.U.2

The main limitations for production include a high erosion hazard, slow to moderate permeability, and some saline areas.

Gullied Land - (Treatment Unit 3). This land type occurs on terraces, benches, valley sideslopes, and eroding stream courses throughout the WMP area. Included with this land type in mapping are small areas of sandstone or shale rock outcrops and small areas of eroded coarse to moderately fine textured soils.

The gullied land miscellaneous area is typically a network of deep, wide, and active gullies extending up stream courses. Over much of the area about 75 percent of the surface layer has eroded away. Parts of the subsoil and underlying layers also may have been eroded. Gullies may be up to 50 feet deep and 100 feet wide. The bottoms are often grassy or shrubby and may be wet.

Sagebrush, Pinyon-Juniper Woodlands - (Treatment Units 4). These soils occur on the periphery of the watershed in areas where the soil developed on sandstone parent material. These soils are gently sloping and include numerous entrenched narrow valleys and canyons that have very steep slopes. They are generally well drained with a low available water holding capacity. These soils have formed in place or from alluvium and wind deposited material derived from calcareous sedimentary rocks. The native vegetation is mainly pinyon, juniper, mountain brush, sagebrush, and grasses.

The soils occurring on ridges and hills are shallow and formed on residuum derived primarily from sandstone. The profile contains many stones and is generally calcareous throughout, medium textured, and underlain by sandstone at 10 to 20 inches. The soils developed on shale are generally steeper, finer textured, and underlain by shale at 10 to 20 inches. There are also areas of very steep slopes of shallow soil which are almost barren.

The soils formed on uplands and terraces in open sagebrush parks are deeper, well drained, and formed in alluvium and from wind deposited material. They are medium textured loams on the surface underlain by moderately fine to fine textures to a depth of 60 inches.

The main limitations for production of this soil group are the short growing season, low precipitation during the growing season, shallow depth to bedrock, high wind and water erosion hazard, steepness of slope, and areas of rock-outcrop which restrict accessibility.

Steep Slope Areas - (Treatment Unit 5). Steep slope areas consist of bedrock outcroppings and badlands. In areas of exposed bedrock about 70 percent of the surface consists of barren rock exposures. Weakly developed coarse or medium textured soils and talus slopes make up the remaining 30 percent. The major portion of the unit is sandstone, but other hard geologic materials may also be present.

The badlands area occurs on rolling to very steep, nearly barren mountainsides, low hills, ridgetops, and canyonsides. Slope is 10 to 65 percent. Areas generally are oval to elongated and are 20 to 300 acres. The native vegetation is mainly very sparse low desert shrub and grasses.

Badland is very shallow and exhibits no significant soil characteristics. The soil material consists of residuum derived primarily from highly calcareous and gypsiferous shale and bentonite

Included in this unit are small areas of Chipeta and Dollard silty clay loams, Moyerson clay loam, and Rock outcrop.

Permeability of badland is very slow. Available water capacity is very low. Effective rooting depth is 0 to 10 inches. Runoff is very rapid, and the hazard of water erosion is very high, which results in a large amount of sedimentation during rainstorms and when snow melts.

Use of this unit is very limited. The bentonite deposits are used locally as a sealing material for canals and ponds.

3. Soil Moisture

In the semi-arid environment of the watershed, moisture is in short supply for at least part of each growing season and therefore, limits plant growth. In this environment, the ability of a soil to hold moisture is at least as important as nutrient availability. Finer textured soils (loam and clay loams) are more effective at holding moisture than coarser textured soils (sandy loams, rocky sandy loams, and very rocky sandy loams) but will hold onto the water more tightly, making it unavailable for plant growth. Soils on steep slopes will generate more runoff than gently sloping soils. The runoff is not available to plants on sites from which it runs off; however, bottomland soils in concave areas receive additional moisture from runoff during periods of moisture recharge. All of these bottomland areas tend to have thicker and more strongly developed horizons, and are more strongly leached. Because of these moisture relationships, the bottomland soils are more productive than sideslopes or uplands because they receive more effective precipitation.

4. Soil Erosion

Soil erosion is controlled by many factors, including climate, vegetation cover, inherent erodibility of the soil, and land use. Of these factors, land use and plant cover are most directly under human control. By increasing plant cover through changing land use, management can reduce erosion below natural rates. This can cause an increase in productivity of eroded sites and decrease downstream sedimentation problems.

Most of the erosion in the watershed occurs during the spring snowmelt and during intense summer thunderstorms both of which cause runoff and flash flooding. Many of the streams have cut deep channels since settlement of the area. Many of these channels continue to erode from gully migration (head cutting) upstream and from the channel bank caving in. In some cases the gully bottoms are naturally revegetating. Upland erosion also occurs due to sheet and rill erosion. Mass wasting is a very localized problem occurring in small areas around the periphery of WMP area, primarily along Coal Ridge.

Water erosion potential of the soils is quite variable. The silt and silt loam surface textures are most susceptible to water erosion. Soils with a high content of organic matter and coarse fragments have very low inherent water erodibility. Fine sands, loamy sands, and coarse sandy loams are most susceptible to wind erosion.

5. Sediment Yield

Soil erosion cannot be directly converted to sediment yields because soil loss calculations do not account for deposition of material prior to its entrance to perennial water courses. The Colorado Land Use Commission (1974) and the SCS (1979) compiled data on sediment yield and erosion potential, respectively. Sediment yield is defined as the average annual amount of sediment from a square mile transported by water from source areas into local water courses. The watershed sediment yield is shown below in five different categories and represents an average over 25 years or more. Refer to Colorado Land Use Commission (1974) for the sediment yield map which shows the location of these categories in the area and to the SCS Erosion Potential Maps for Moffat and Rio Blanco Counties (SCS 1979).

1. Severely eroding stream banks and gullies with an average depth of 5 feet or more yield from 1.0 to 2.0 acre feet per bank mile per year (3 to 6 tons/ac/yr). This occurs along the major drainages and side draws below Pinyon Ridge on the east side of the watershed.
2. Very high yield [1.0 to 3.0 acre-feet per square mile per year (3 to 9 tons/ac/yr)] includes badlands or other severely eroded lands with extensive sheet and rill erosion and numerous deep gullies. These locations are found in the center of the watershed from soils formed on Mancos Shale.
3. High yield [0.5 to 1.0 acre-feet per square mile per year (1.5 to 3 tons/ac/yr)] includes the majority of the watershed. It consist of rangeland with much sheet and rill erosion and numerous shallow to moderately deep gullies.
4. Moderate yield [0.2 to 0.5 acre-feet per square mile per year (.7 to 1.5 tons/ac/yr)] includes the area around the

edges of the watershed. This is mostly rangeland with only a few shallow to moderately deep gullies and some rills and gullies.

5. Low yield [0.1 to 0.2 acre-feet per square mile per year (.3 to .7 tons/ac/yr)] includes the sagebrush parks on the edges of the watershed. These areas have good vegetation cover and only occasionally have gullies or sites with obvious sheet and rill erosion.

G. Hydrology

1. Surface Water

Lower Wolf Creek consists of the main stem of Wolf Creek and four main tributaries: Coal Creek, East Fork Wolf, Middle Fork Wolf, and Divide Creek, all of which are intermittent streams.

| <u>Tributary</u> | <u>Acres</u> | <u>% of WMP area</u> |
|------------------|---------------------|----------------------|
| Coal Creek | 18,565 acres | 24% |
| East Fork | 9,570 acres | 12% |
| Middle Fork | 17,640 acres | 23% |
| Divide Creek | 4,280 acres | 5% |
| Main Stem | 28,040 acres | 36% |
| | <u>78,095 acres</u> | <u>100%</u> |

The hydrologic setting of the Lower Wolf Creek Basin ranges from relatively low lying, semi-arid lands yielding relatively little flow to steep, moderately high mountains that contribute the major stream flow of Wolf Creek. Runoff from arid areas is generally from high intensity spring and summer thunderstorms and from snow melt from March through May. These lands typically yield small amounts of water per year, usually less than one inch per square mile.

The upper portion of Wolf Creek drainage provides the only perennial stream segments of the watershed. The flow of these streams can be divided into two parts: (a) base flow and (b) high runoff. The base flow during the low flow period (mid-July through mid-March) comes primarily from groundwater.

High runoff generally occurs from mid-March through mid-June and is caused primarily by melting of the higher elevation snowpack. Transitional months are usually March and July. Early season runoff is generally from lower elevation snowmelt and may provide a separate and lower discharge peak than the main peak in the hydrograph, which usually occurs in late May and early June.

2. Groundwater

Groundwater occurs in many geologic units within the watershed, although only four are considered to be viable and usable sources. These four are the Mesa Verde group, the Browns Park Formation, the Glen Canyon sandstone, and the alluvium throughout the watershed.

The entire Mesa Verde group consists of undifferentiated sandstones, shales, siltstones, and coal seams. Both the permeabilities and yields of these formations are considered very low, averaging less than 10 gallons per minute.

The Browns Park Formation is soft friable crossbedded sandstone with substantial quantities of water to the north and east of the WMP area at depths of several hundred feet. The northeastern boundary of the watershed fringes upon this area.

The Glen Canyon sandstone is located along the northwest edge of the lower watershed and consist of fine grained crossbedded sandstone which is 700 to 800 feet thick. At least 11 wells are completed in the Glen Canyon sandstone within the lower watershed. Seven of these are located in Sections 27 and 34 of Township 4 North, Range 100 West, on privately owned land. Four other free flowing (artesian) wells are located in the same area of the sandstone outcrop. Three are located on private land; the remaining well is on public land.

The alluvium is composed of silt, sand, and gravel and is located along most drainages in the watershed. The alluvium is saturated only a few feet below the surface in many of the drainages, although most streams remain dry throughout the larger portion of the year.

Natural flowing perennial springs are quite sparse in the lower watershed. Only four springs are known to flow continuously throughout the year. These are saline springs emerging through the Mancos Shale both in the upper central portion of the lower watershed and from the upper reaches of Coal Creek. (Appendix D expands on known data of the wells and springs within the Watershed.)

Recharge occurs from two areas in the watershed. These hydraulic gradients are to the east of the Skull Creek anticline and to the west and south of Elk Springs anticline, both trending toward the center of the lower watershed.

Discharge from the formations in the watershed roughly follows the south-oriented limb of the anticlines toward the White River and the north-oriented limb to the Yampa River on the extreme northern portion of the watershed near Elk Springs.

2. Water Quality

Water quality varies in the watershed depending upon formations stream location, season of year, and diurnal fluctuations. Chemical water quality is reported as total dissolved solids (TDS) concentration in either milligrams per liter (mg/l) or parts per million (ppm); these are used interchangeably for concentrations below 7,000 mg/l. The terms salinity and TDS are also used interchangeably in this plan.

Water from the higher mountain runoff contains lower concentrations of salts with calcium bicarbonate predominating. As water moves through the lower reaches of the system, the major constituents typically change from calcium bicarbonate to calcium sulfate, sodium sulfate, and sodium chloride. This shift is influenced by factors such as (a) a change in the salinity of the alluvial material that water contacts, (b) the chemical makeup of soils and geologic formations contributing surface runoff and groundwater, and (c) the relative cation-anion exchange activity between salt producing ions. Sodium and chloride are the most active ions and tend to replace or exchange with other elements in solution.

The runoff from the watershed provides a medium for salt and sediment transport and is a function of the amount and intensity of precipitation. Salts are dissolved from the soil surface by runoff, from evaporates in channels, and from sediment particles being transported in channel flow. Groundwater from the saline geologic formations in the watershed typically contain salts in concentrations two to three times greater than in surface discharges.

4. Drainage Features

The watershed is characterized by a parallel drainage pattern tending toward the south. This is highly evident in the northeast section of the watershed near Elk Springs. The southerly pronounced slope is structurally controlled by Pinyon Ridge and Coal Ridge, which taper the four main tributaries into the main channel of Wolf Creek approximately 2 miles from the confluence with the White River. The entire Lower Wolf Creek watershed is uniformly covered with drainage channels ranging from 1.21 miles in length per square mile to a high of 1.67 miles per square mile. A stream order map was completed on 7.5 minute topographic quads; this map is available at the White River Resource Area Office.

5. Water Rights

Water rights allocated by the state of Colorado within the Lower Wolf Creek Watershed are listed in Table 1 and Table 2.

6. Existing Watershed Projects

Reservoir construction and vegetation manipulations in the WMP area were completed in 5 different unrelated time periods. Work began in the late 30's with the CCC efforts and has continued in a haphazard manner, up to the present.

The existing project locations and current condition is listed in Appendix E and F for watershed and vegetation manipulation projects.

TABLE 1 - PUBLIC WATER RIGHTS

| Structure | Source (River) | Location | Date of Appropriation | Amount | Type of Use | Priority Date |
|--|-------------------|-----------------------------------|--------------------------|------------|--|------------------|
| Divide Creek Detention Dam | White | SW1/4 of Sec. 13, T3N, R100W | 1/20/59 | 304 ac ft | recreation, wildlife, erosion control | 1/20/59 |
| North Coal Reef | White | SW1/4SE1/4 of Sec. 22, T3N, R99W | 11/12/66 | 3.0 ac ft | livestock, wildlife | 11/12/66 |
| Winter Valley Dam No. 4 | White | NE1/4NW1/4 of Sec. 12, T3N, R99W | 6/14/71 | 4.0 ac ft | livestock, wildlife, erosion control | 6/14/71 |
| Lower Winter Valley Dam No. 1 | White | NW1/4NE1/4 of Sec. 12, T3N, R99W | 6/18/71 | 4.0 ac ft | livestock wildlife, erosion control | 6/18/71 |
| Mancos Reservoir No. 3 | White | NE1/4NE1/4 of Sec. 13, T4N, R100W | 11/12/57 | 5.0 ac ft | livestock, wildlife, erosion control | 11/12/57 |
| Mancos Reservoir No. 1 | White | NE1/4SE1/4 of Sec. 7, T4N, R99W | 10/26/57 | 7.0 ac ft | livestock, wildlife, erosion control | 10/26/57 |
| Divide Creek Check Dam No. 1 | White | SE1/4SW1/4 of Sec. 18, T3N, R99W | 11/25/66 | 10.0 ac ft | livestock, wildlife, erosion control | 11/25/66 |
| North Coal Ridge Check Dam No. 3 | White | NE1/4NE1/4 of Sec. 24, T3N, R100W | 11/14/66 | 2.0 ac ft | livestock, wildlife, erosion control | 11/14/66 |
| Upper Middle Fork Wolf Creek Check Dam No. 3 | White | SW1/4SW1/4 of Sec. 17, T4N, R99W | 5/9/66 | 10.0 ac ft | livestock, wildlife, erosion control | 5/9/66 |
| Upper Middle Fork Wolf Creek Check Dam No. 5 | White | SE1/4SW1/4 of Sec. 17, T4N, R99W | 5/11/66 | 9.0 ac ft | livestock, wildlife, erosion control | 5/11/66 |
| Upper Middle Fork Wolf Creek Check Dam No. 7 | White | NE1/4NE1/4 of Sec. 19, T4N, R99W | 5/11/66 | 10.0 ac ft | livestock, wildlife, erosion control | 5/11/66 |
| Middle Fork Wolf Crk Check Dam No. 1 | White | NW1/4NE1/4 of Sec. 20, T4N, R99W | 4/21/66 | 4.0 ac ft | livestock, wildlife, erosion control | 4/21/66 |

TABLE 2 - PRIVATE WATER RIGHTS

| Structure | Source (River) | Location | Date of Appropriation | Amount | Type of Use | Priority Date |
|------------------|-------------------|---------------------------------|--------------------------|-----------|-----------------------------------|------------------|
| Pitman #1 Well | Ground- water | NW1/4NW1/4, Sec. 34, T4N, R100W | 3/1/39 | .033 cfs | irrigation, domestic livestock | 12/31/72 |
| Pitman #2 Well | Ground- water | NW1/4NW1/4, Sec. 34, T4N, R100W | 7/1/43 | .033 cfs | irrigation, domestic livestock | 12/31/72 |
| Pitman #3 Well | Ground- water | NW1/4SE1/4, Sec. 34, T4N, R100W | 6/5/145 | .033 cfs | irrigation, domestic livestock | 12/31/72 |
| Wear #1 Well | Ground- water | SW1/4NW1/4, Sec. 27, T4N, R100W | 5/15/43 | .201 cfs | irrigation, domestic livestock | 12/31/72 |
| Yellow Cat Well | Ground- water | NW1/4NE1/4, Sec. 27, T4N, R100W | 5/1/46 | .134 cfs | irrigation, domestic livestock | 12/31/72 |
| Peterson #1 Well | Ground- water | SW1/4SE1/4, Sec. 15, T4N, R100W | 6/1/47 | .223 cfs | irrigation, domestic livestock | 12/31/72 |
| Peterson #2 Well | Ground- water | NE1/4SW1/4, Sec. 22, T4N, R100W | 6/1/47 | .223 cfs | irrigation, domestic livestock | 12/31/72 |
| Wear #3 Well | Ground- water | SW1/4NW1/4, SEC. 27, T4N, R100W | 12/1/48 | .0110 cfs | irrigation, domestic livestock | 12/31/72 |
| Pitman #4 Well | Ground- water | NW1/4SE1/4, Sec. 34, T4N, R100W | 8/15/67 | .055 cfs | irrigation, domestic livestock | 12/31/72 |

H. Vegetation

1. Introduction

The discussion of vegetation is centered on the major vegetation communities occurring in the watershed, with emphasis on the existing composition, plant cover, and productivity. This information has been obtained from the SCS Range Site descriptions, which are correlated to the SCS soil mapping units (refer to Appendix G), the Phyto-Edaphic Classification of the Piceance Basin (Tiedeman and Terwilliger, Jr. 1978), and the Final EIS for the White River Resource Area Grazing Management (USDI, BLM 1980).

The majority of the native plants make their main growth from mid-April to the end of June, primarily on stored winter moisture. Cool season plants are favored because of the June droughts and the best growth is made following spring thaw and again in early fall following late summer rains. The area is generally dry from mid-June to mid-August. There is sometimes fall growth from late summer rain in August and September. Wide yearly and seasonal fluctuations are common. The frost-free period is generally 150 days or more.

The average annual moisture deficit is high, more than 50 inches. Moisture that comes during hot summer weather does little for plant growth, except for late in the summer.

Saltbush Community (Treatment Unit 1). The saltbush vegetation community is located on the shallow soils formed on Mancos Shale in the center of the watershed. The community consists of salt tolerant semi-desert shrubs and a few salt tolerant grasses and forbs. Mat saltbush occurs on the very shallow soils on ridgetops, then grades into shadscale on the moderately deep soils on sideslopes. The potential exists for fourwing saltbush in areas of deep alluvial soils, which receive some additional run-on moisture.

Dominant shrubs include gardner's saltbush, mat saltbush, shadscale, bud sagebrush, big sagebrush and winterfat. Associated species are salina and Colorado wildryes, bottlebrush squirreltail, western wheatgrass, and cheatgrass. Refer to Appendix H for plant species names.

The saltbush association occurs below 6,000 feet and is found on lower elevation foothill slopes, semi-arid drainage bottoms, and alluvial deposits. Saltbush occupies heavy, fine textured soils that are less saline-alkaline than those which normally support greasewood. Saltbush communities are characterized by low growing, widely spaced plants that vary in species composition and density. These communities range from pure stands of an individual saltbush species to intermixed communities of many species.

Overall basal cover in the saltbush type averages 15 percent, with the shrub component making up most of the cover percentage. Productivity is presently below the climax potential. Based on U.S. Soil Conservation Service data, productivity could range from 50 lbs/acre on poor condition range to 350 lbs/acre on good condition range.

Greasewood Community (Treatment Unit 2 and 3). The greasewood community is most prevalent on deep, poorly drained, alluvial saline-alkaline soils that receive additional run-on moisture. This is the only vegetation community in which the vegetation brings salts to the surface.

Greasewood occurs both in dense and open stands with varying amounts of understory vegetation. Major associated species are big sagebrush, gardner saltbush shadscale, rubber rabbitbrush, western wheatgrass, cheatgrass, mustard, and Russian thistle.

Greasewood is the dominant shrub species in this community. Very dense stands can have a nearly closed canopy with little understory vegetation cover, while more open stands support more diverse understory vegetation. The average basal cover of greasewood and associated shrubs and grasses is 28 percent. Productivity in the greasewood stand varies with greasewood density, ranging from 400 to 700 lbs/acre.

Riparian Vegetation (Treatment Unit 3). The riparian vegetation of the planning area is generally associated with small perennial streams, man-made reservoirs and stock ponds holding year-round waters, and spring sources. Riparian plant communities or zones are narrow bands that follow stream courses and are very distinct from adjacent rangeland plant communities. Riparian vegetation communities are limited by stream widths and by the steep banks of eroded gullies. Narrow zones, 1 to 5 feet across, are typical at higher elevations and spread out gradually to as much as 50 to 75 feet in lower elevations. These communities are important because they support higher population densities and greater diversities of both plant and animal species than any other rangeland plant community. The average perennial basal ground cover is about 75 percent.

The dominant plant species include willows, tamarisk, scattered cottonwoods, and basin big sage. In areas of perennial water sedges, rushes, foxtail barley, and cattails exist.

Sagebrush Community (Treatment Unit 4). The sagebrush stands are characterized by mixed high and low growing shrubs dominated by big sagebrush with a wide variety of understory grasses and forbs. The sagebrush type occurs at all elevations, with the larger expanses occurring below 7,000 feet.

Major plant species associated with sagebrush at lower elevations are western wheatgrass, salina and Colorado wildrye, Indian ricegrass, needle-and-thread, Sandberg's bluegrasses, and

galleta. Associated species above 7,000 feet are various wheatgrasses, bluegrasses, needlegrasses, and lupine.

Cover varies throughout the community. In some instances big sagebrush dominates a site, contributing almost 100 percent of the total cover, while on other sites it may contribute less than 20 percent. Basal cover attributed to all species occurring in the community, based on available data, averages 30 percent.

Productivity of the sagebrush community is also highly variable. Dense stands support very little understory vegetation, while open stands can produce from 800 to 1,800 lbs/acre.

Pinyon-Juniper Woodland (Treatment Unit 5). The pinyon-juniper woodland occurs around the edges of the watershed and in a few small locations in the northern portion of the area. Pinyon and Utah juniper are the dominant overstory species. Major understory species include Utah serviceberry, mountain mahogany, big sagebrush, bitterbrush, junegrass, beardless bluebunch wheatgrass, Indian ricegrass, and galleta.

This community occurs on a wide variety of sites with respect to elevation, slope and aspect. Most are found between 6,500 feet and 8,000 feet in elevation on ridgetops and sideslopes on all aspects wherever acceptable soils exist. The pinyon-juniper woodland varies considerably with respect to species composition, wood volumes and forage production. Depending on the quality of the site, the overstory will vary from pure juniper to pure pinyon, from very sparse and scattered to closed canopied, and from seedling/sapling stages to large, overmature stands. Where a dense overstory exists, little or no herbaceous understory vegetation occurs, although desirable browse production may be significant. Basal vegetation cover for herbaceous species ranges from 10 to 15 percent while tree canopy cover ranges from 15 to 35 percent, for the pinyon-juniper woodland. Most woodland stands will exhibit variation in size and age classes, due to their unmanaged status. Best development usually occurs on ridgetops and north-facing slope stands between 7,000 and 7,500 feet in elevation.

On areas disturbed by fire, pinyon-juniper is confined primarily to rocky ridges and slopes. On areas relatively undisturbed by fire, pinyon-juniper extends into flatter areas with deeper soils.

Forage production varies with pinyon-juniper density and can range from virtually no understory production up to 300 lbs/acre in good condition stands.

Barren and Waste Lands (Treatment Unit 5). Barren lands are areas such as barren rock, erosion pavements, or rock outcrops which have no significant amount of vegetation. Waste lands are areas which are too steep and/or rocky to be beneficial to livestock or big game. These areas include steep inclines such as cliffs and

rockslides. These two land categories are found in isolated areas, primarily along Pinyon Ridge.

2. Threatened/Endangered, Rare and Sensitive Plants and Remnant Vegetation Association.

Based on the habitat requirements for known threatened, endangered, and sensitive plant species, there is little chance they occur in the WMP area.

I. Wildlife

1. Terrestrial

The Lower Wolf Creek WMP area encompasses a large area used extensively by many wildlife species. Only those indicator species currently targeted for intensive management by BLM and the Colorado Division of Wildlife will be addressed in this document. For a listing of all species inhabiting typical vegetative types associated with the WMP area, refer to summarizations included in the White River Resource Area Management Framework Plan and Rangely N1/2 Unit Resource Analysis.

Because of the scope and format of the WMP, discussions of wildlife numbers and habitat use will be abbreviated and generalized. Prior to implementation of individual projects, specific wildlife information will be provided for detailed impact analysis.

a. Big Game

With the exception of perimeter pinyon-juniper ranges, essentially all the WMP area is used spring, summer, and fall by pronghorn antelope. Current population estimates put the resident herd at 250 to 300 head. One important use area exists, a fawning concentration area located in the Lower Horse Draw/Wolf Creek area.

Mule deer use is confined primarily to pinyon-juniper ranges on the outer perimeter of the Lower Wolf Creek watershed. Seasonal use is overwhelmingly winter oriented. Important use areas consist of severe winter concentration areas located on the east and west margins of the WMP area. Summer/fall use is relegated to a small portion of the WMP area located above the Skull Creek rim.

Elk occupy the northern half of the WMP area. Their use consists of low density year-round residency on Pinyon Ridge, Elk Springs Ridge, Winter Valley Gulch, and the Upper Coal Creek country; moderate density winter use of the Baking Powder Ridge/Maverick Flats area; and low to moderate density spring/fall use above the Skull Creek rim. Important use areas include a calving area delineated on Elk Springs Ridge.

b. Sage Grouse

Sage grouse occupy suitable sagebrush habitat throughout the Wolf Creek watershed on a year-round basis. No population or distribution information exists on which to base estimates of flock size, or seasonal range use. Three strutting grounds have been located to date, although it is conceivable that several may yet be discovered. Studies indicate that 80 to 90 percent of all grouse nests are located within a two-mile radius of a strutting ground, however brood-rearing and winter use areas may be widely removed from breeding areas.

c. Raports

Raptors are prevalent throughout the WMP area on a year-round or seasonal basis. Pertinent information on common raptors relative to the watershed is tabulated below:

| <u>Species</u> | <u>Primary Status</u> | <u>Number of Located Nests</u> |
|--------------------|-----------------------|------------------------------------|
| Golden eagle | Resident | 17 |
| Ferruginous hawk | Breeder | 16 |
| Bald eagle | Winter/migrant | -- |
| Red-tailed hawk | Resident | 3 |
| Rough-legged hawk | Winter | -- |
| Prairie falcon | Resident | 1 |
| American kestrel | Breeder/migrant | 0 |
| Marsh hawk | Resident | 1 |
| Cooper's hawk | Resident | 0 |
| Sharp-skinned hawk | Migrant/winter | -- |
| Great-horned owl | Resident | 1 |
| Long-eared owl | Breeder | 0 |
| Burrowing owl | Breeder | 0 |

2. Threatened and Endangered Species

Bald eagles regularly forage over the saltbush/sagebrush type within the WMP area from October through April. Foraging activities are dispersed and opportunistic; no concentrated or preferred use areas have been identified in the WMP vicinity.

White-tailed prairie dogs, whose "towns" are considered potentially suitable habitat for the black-footed ferret, occur throughout the WMP area in the sagebrush/saltbush association. Numerous unsubstantiated ferret sightings have occurred in 1982 and 1983 along Highway 40 from Massadona to Dinosaur, CO. These sightings indicate a very real potential for ferret habitation of the WMP area's extensive prairie dog towns.

Colorado squawfish use of the White River from Rio Blanco Lake to its confluence with the Green River has been well documented by past and recent U.S. Fish and Wildlife Service

(USFWS) and Colorado Division of Wildlife studies. Besides being of at least seasonal value to squawfish, the White River is perhaps most valuable to listed fishes as a flow contributor (flow volume and periodicity) to the Green River. Major Green River tributaries, such as the White, are thought to exert a strong influence on the reproductive success of endemic fish in the Green River.

Greater sandhill cranes migrate regularly through the WMP area and infrequently use the saltbush/sagebrush association for periods of short-term foraging and rest. Small numbers of whooping crane are associated with migrating sandhills, this being attributable to an ongoing reintroduction program being conducted by the USFWS. Any crane use of the WMP area is considered incidental, migration-related stopover because, (1) preferred habitat is extremely limited in extent and quality, (2) all sightings are made concurrent with migratory seasons, and (3) observations involve small numbers of crane in flight or making short duration ground use.

J. Livestock

The project area encompasses nine grazing allotments. These allotments are used by both cattle and sheep, mainly during the winter and spring (Nov.-May). Some use also occurs at other times during the year, although most grazing is over by May 30 within the watershed area.

One allotment is presently under an allotment management plan in which specific resource objectives have been defined. These objectives and goals can be enhanced/benefitted by the watershed program objectives listed in this document. See Table 3 for an affected allotment summary.

TABLE 3 -- ALLOTMENT SUMMARY

| No. | Name | Class | Seasons | Preference AUMs | Actual Use | % Allot in Water- shed Area |
|------|------------------|---------------|----------------|--------------------|------------|-----------------------------------|
| 6324 | Massadona | Cattle/Sheep | Nov 1-May 20 | 1,167 | 1,167 | 35% |
| 6334 | Coal Reef | Cattle | Nov 9-Dec 15 | 200 | 200 | 50% |
| 6332 | Horse Draw | Sheep | Dec 10-Apr 8 | 1,547 | 1,300 | 100% |
| 6331 | Baking Powder | Sheep | Dec 9-Jan 24 | 565 | 565 | 100% |
| 6333 | Pinyon Ridge | Cattle/Sheep | Apr 1-June 30 | 700 | 700 | 40% |
| 6330 | Upper Coal Crk | Sheep | Jan 23-Apr 14 | 880 | 650 | 100% |
| 6329 | Winter Valley Gl | Cattle | May 15-Nov 15 | 144 | N/U | 100% |
| 6326 | Elk Springs | Sheep | Nov 10-June 15 | 2,497 | 1,500 | 95% |
| 6323 | Wolf Creek | Cattle/Horses | year-round | 4,362 | 3,500 | 30% |

K. Cultural Features

Several small Class III cultural resource inventories have been conducted within the WMP area. These inventories have been both areal

and linear in nature. A total of 34 cultural resources have been located and recorded. Sites are located in a variety of edaphic/topographic environments, including ridgetops, benches, bajadas and valley bottoms. Sites include prehistoric (open camp, open lithic and sheltered) and historic components. The prehistoric sites appear to coincide with Archaic, Fremont and Protohistoric cultural groups. Sites along the Skull Creek Rim and Skull Creek Basin appear to be heavily influenced by the Fremont, with a preponderance of masonry storage structures located above possible arable lands.

L. Aesthetic/Visual Resources (VRM)

The proposed action is not in a designated scenic area. The degree of visual impacts created by the proposed action is determined to be compatible with the visual management system in this area, and does not require a contrast rating.

M. Recreational Resources

The major form of recreation on the watershed is hunting. Due to the close proximity of the towns of Rangely and Dinosaur, a moderate amount of hunter oriented activity takes place, primarily during the big game seasons for deer and antelope. To a lesser extent, prairie dog shooters visit the allotment during the summer and fall.

Furbearers, including coyote, bobcat, muskrat, badger, and weasel are widely distributed in suitable habitat throughout the WMP area. Seasonal trapping effort is directly correlated with current fur price structures. High demand and increasing pelt value stimulates both the number of persons participating, and the number of days expended in trapping efforts.

Fishing had occurred at the Divide Creek Detention Dam as it was stocked with fish by the Colorado Game and Fish Department soon after it was built in 1958. Limited evidence of fish remain, but the potential exists for restocking the Divide Creek Detention Dam.

Off-road vehicle (ORV) use is becoming increasingly popular around the Rangely area. Within the WMP area, evidence of this sport is rarely visible on ridges of the Mancos Shale Formation. Presently, the watershed has not been impacted by ORV use.

N. Wilderness

No wilderness study areas would be affected by this WMP area.

O. Social Aspects, Economics

The area is used for ranching and seasonal hunting. Some oil and gas development has occurred in the northeast portion of the watershed. The social aspects and economics of the area are based on the above uses. The area is important to permittees' livestock operations.

IV. PROJECT IMPLEMENTATION - PLANNED ACTION

A. Preliminary Strategies

1. Introduction

In order to implement the watershed goals and objectives, this plan has divided the Lower Wolf Creek watershed into treatment units to locate new construction and vegetation improvement (Figure 6). Predominant physical characteristics such as soils, vegetation, and topography as grouped by range sites were used to define treatment units and to determine their management capabilities or the best management practices (as recommended in the Colorado West Area Council of Government's 208 Plan for this area). Because their soils, slope, and small watershed areas, certain areas are best suited for gully plugs or spreader dikes. Other treatment units with gentle slopes, undesirable vegetation, and potentially productive soils, are suitable for vegetation manipulations.

Some land forms do not fit into these units. Other are transitional between distinct treatment units, and may overlap unit boundaries.

Maintenance of roads and existing projects will be included in Treatment Units 1 through 4.

2. Treatment Units

Treatment Unit 1 - Mancos Shale Uplands. This unit occurs in the center of the lower watershed and is the priority treatment area. It occupies 42 percent of the watershed area. It consists of upland Mancos Shale ridges, and areas of shallow soil. Slopes are gentle to moderately steep and vegetation is sparse. This unit is dissected by numerous discontinuous gullies.

The dominant vegetation is the saltbush community. Range sites that make up this unit are Clayey Slopes, Clayey Foothills, Loamy Saltdesert, Sandy Saltdesert, Saltdesert Breaks, Clayey Saltdesert, Semi-Desert Clay Loam, and Semi-Desert Loam.

The Rio Blanco Soil Mapping Units include Chipeta silty clay loam (17), Chipeta-Killpack silty clay loams (18), Cliffdown-Cliffdown Var. Complex (21), Dollard silty clay loam (31), and Moyerson stony clay loam (53); Moffat County Mapping Units include Abor silty clay loam (4E), Kinnear loam (12D), Yamac loam (32D), Yamac loam (32E), Pinelli loam (33D), Bulkley silty clay loam (58D), Bulkley silty clay loam (58E), Begay loamy fine sand (93), Kemmerer-Moyerson silty clay loams (105), Kemmerer silty clay loams (110E), Kemmerer-Yamac Complex (x110), Deaver-Chipeta silty clay loams (x121), Torriorthents-R0 Shale Complex (133), Unnamed A-Unnamed B Complex (201), and Deaver-Michey Complex (202). The main soil limitations for



FIGURE 6
TREATMENT UNITS

- 1. Mancos Uplands
- 2. Mancos Alluvium
- 3. Gullied Alluvium
- 4. Sagebrush Uplands
- 5. Pinon-Juniper Woodlands

production include, shallow depth, heavy textures, low available water holding capacity, high shrink swell potential and highly saline areas.

Improvements recommended for this unit are very extensive and include primarily gully plugs and check dams. Other improvements include vegetation manipulations, grassed waterways, contour furrows, spreader dikes, pits, drop structures, and disturbed area protection in favorable locations.

Treatment Unit 2 - Mancos Alluvium. Smaller drainages, dissected benches and fans at the base of Mancos Shale outcrops characterize this unit. It occupies 24 percent of the watershed area. Erosion is severe and sediment yield is very high. This site is very suited to reservoir construction since the gypsum has been leached from the soil.

The dominant vegetation community is greasewood and big sagebrush. Range sites that make up this unit are Saltdesert Overflow, Foothills Swale, and Alkaline Slopes. Rio Blanco Soil Mapping Units include Billings silty clay loam (7), Billings-Torrifluvents Complex Gullied (8), Turley fine sandy loam (93), Turley fine sandy loam (94), and Uffens loam (95), and soil mapping units in Moffat County are Havre fine sandy loam (03B), Glendive loam (04A), Panitchen sandy loam (05), Natrargids (123), Notal Var. silty clay loam (138), and Sili-Panitchen loam (200). The major soil limitations for production include, medium textured soils, saline areas and occasional high water.

Improvements recommended for this unit are pits, reservoirs, spreader dikes, vegetation manipulations and grassed waterways.

Treatment Unit 3 - Gullied Alluvium. This unit consists of large drainages characterized by major gullied bottomlands associated with steep banks, and meandering channels. These are located in high order drainages. It occupies four percent of the watershed area. The dominant vegetation community is presently low quality riparian. This unit is composed of Rio Blanco Soil Mapping Unit Torrifluvents, Gullied (90) and Moffat County Mapping Units Glenton loamy fine sand (91) and Gullied land (RG). There are no identified range sites; the unit is characterized by miscellaneous landforms such as gully land.

Improvements recommended for this unit include riparian planting and large detention reservoirs. If funding allowed the reservoirs could be built by the Bureau of Reclamation.

Treatment Unit 4 - Sagebrush Uplands. This unit occurs around the edge of the watershed on soil derived primarily from sandstone. It occupies seven percent of the watershed area. It is of low priority for treatments. However, it will be important to intercept runoff on this area before it flows onto the easily erodible Mancos Shale.

The dominant vegetation community is upland big sagebrush. The range sites include Mountain Loam, Dry Mountain Loam, Deep Loam, Sandhills, Rolling Loam, Loamy Breaks, Sandy Foothills, Gravelly 7-14, Loamy 10-14, and Semi-Desert Sandy Loams.

Rio Blanco Soil Mapping Units include Clayburn loam (20), and Forelle loam (33); the Moffat County Soil Mapping Units include Unnamed loamy sand (13C), Work loam (17E), Cruckton loamy sand (23D), Cruckton loamy sand (23E), Berlake sandy loam (26D), Forelle loam (28D), Forelle loam (28E), Hereford sandy loam (39C), Cushool fine sandy loam (52D), Zeona loamy sand (54X), Zeona loamy sand (56), Rock River sandy loam (62D), Grieves loamy fine sand (63D), Forelle-Evanston loams (64D), Terada Variant cobbly sandy loam (88F), Almy very fine sandy loam (92), Yetull-Crestman loamy sands (115), Spool-Unnamed loamy fine sands (124), Browns to-Luhon Complex (142), and Niart-Browns to Var. Garza Var. Complex (147). This unit has few soil limitations for production.

Improvements recommended for this unit include vegetation manipulation such as seedings and burnings. Structures would include small pits and reservoirs.

Treatment Unit 5 - Pinyon-Juniper Woodlands and Steep Slopes. This unit occurs primarily around the periphery of the watershed. It occupies 23 percent of the watershed area. Treatments are not recommended in this unit due to shallow soil, inaccessibility and steep slopes.

The dominant vegetation is Pinyon-Juniper Woodland and barren areas. The range sites occurring on this unit include: Pinyon-Juniper Woodland, Stony Foothills, Dry Exposure, Rock Outcrop, and Badlands.

The Rio Blanco Mapping Units include Badlands (5), Rentsac channery loam (73), Rentsac-Moyerson-RO Complex (74), Rock Outcrop (78), and Torriorthents-RO Complex (91); and Moffat County Soil Mapping Units include Moyerson-Rentsac Complex (9E), Grieves-Yamac-Crestman Assoc. (x9E), Rentsac-Moyerson-RO Complex (11E), Torriorthents-RO Complex (101), Grieves-Crestman-Cushool Complex (116), Schooner - RO Complex (122), Schooner-Mesapun loamy sands (x122), Torriorthents/Torripsamments (132), Kemmerer-Tridell Var. Complex (149), Rockoutcrop-Torriorthents Complex (RL). This unit has severe soil limitations for any use, which includes very shallow soil and heavy textures.

Refer to Table 4 for the prescribed structures for treatment units under the various alternatives.

3. Ranking

Treatment Unit 1 will receive the highest priority due to the high soil salt content. Unit 2 will receive second priority, Unit 3 third priority, Unit 4 fourth priority, and Unit 5 will not receive any treatments.

TABLE 4
PRESCRIBED STRUCTURES FOR TREATMENT UNIT UNDER THE VARIOUS ALTERNATIVES *

| | Unit 1 | Unit 2 | Unit 3 | Unit 4 | Units |
|-----------|-------------------------|--|--------|--------|-------|
| No Action | None | None | None | None | None |
| Minimum | GP, CD | CF, CD, PR, RD | DD | None | None |
| Low | CF, RS, BC, CAP, DAP | RS, BC, GW, T&S, C&S | T&S | BC, RS | None |
| Moderate | GP, CF, RS, CAP, DAP | RD, CD, PR, CF, T&S, DD D&D, RS, BC, GW, DAP | | BC, RS | None |
| High | CD | CD, PR, RD, S, DD, J&J, C C, CAP, D&D | | BC, RS | None |

* Footnotes for Array of Project Alternatives

| | | |
|---------------------------------|------------------------|--------------------|
| T&S - Tree and Shrub Planting | RD - Retention Dam | BC - Brush Control |
| GW - Grassed Waterways | CB - Controlled Burn | PR - Pit Reservoir |
| CAP - Critical Area Planting | CD - Earth Check Dam | RS - Range Seeding |
| C&S - Chiseling and Subsoiling | CT - Contour Terracing | GP - Gully Plugs |
| D&D - Diversions and Dikes | CF - Contour Furrowing | DD - Detention Dam |
| DAP - Disturbed Area Protection | | |

Divide Creek will be the first tributary to receive attention. Reservoir and road maintenance is needed to extend the life of existing projects in this area. The Coal Creek drainage area will be dealt with next since this tributary is showing the most active erosion. New construction of engineered structures and vegetation manipulations are planned for this area. The East Fork of Wolf Creek will be the third area to receive implementation. The Middle Fork and the main stem of Wolf Creek will be the last two areas of implementation since they are presently more stable than the other tributaries.

B. Alternatives

The Moderate Action Alternative, is the Preferred Alternative. Site specific planning will not be incorporated in this document since the level of implementation will vary from year to year, being dependent upon funding and personnel levels. Therefore, it has not been determined when each area will be receiving attention..

Alternatives are provided here, to portray the magnitude of work that can be accomplished at the various funding levels.

1. No Action -- No soil water and air projects, range management only.
2. Minimal -- Soil, water and air funds for severest erosion in Treatment Unit 1.

3. Low -- Small projects and vegetation improvements aimed at sediment control in Treatment Units 1 and 2.
4. Moderate -- Balance of projects and vegetation treatments and intense resource management in Treatment Units 1 through 4.
5. High -- Heavy emphasis on fast, effective engineered projects, in Treatment Units 2 and 3.

1. No Action

This alternative would emphasize range management through recommended actions, proposed in the White River Grazing EIS. Projects and funding would originate from the range program and would be implemented in line with AMPs. No direct priority would be given to sediment or salt control. There would be no attempt at controlling ORV or wet soil road closures. Maintenance of existing projects would be according to permittee cooperative-agreements and maintenance cycles according to JDRs implemented by BLM Division of Operations.

2. Minimum Action - Crisis Erosion Alternative

This alternative addresses only those areas with the most severe erosion problems. A minimal amount of new construction would attempt to retain sediment. Only those projects with the highest cost effectiveness would be undertaken. Range management would be according to the White River Grazing EIS and maintenance of existing projects would be as described for the No Action Alternative.

3. Low Action - Vegetation Alternative

This alternative would emphasize watershed protection through vegetation treatments, reseeding, and water retention structures. Projects would be designed to enhance infiltration and favorable soil moisture for maximum plant growth. This alternative would provide for gully plugs and small reservoirs to retain runoff, but major structures would not be built with soil, water and air funds. Maintenance of existing projects would also include effective vegetation reestablishment on old projects. ORV use would be controlled during the growing season and seasonal road closures would be enforced.

4. Moderate Action - Balanced Alternative (Preferred)

The intent of this alternative is to design cost-effective treatments to reduce soil erosion and salinity by using a balance of engineered structures and vegetation manipulations. Structures (retention dams, reservoirs, etc.) would be prescribed for the majority of sediment control. Priorities for new construction would emphasize protection systems for whole tributary areas and maximum cost effectiveness. Vegetation treatments would be recommended where the best watershed cover could be established and where infiltration could be enhanced. Seasonal road closures would be enforced. This alternative would also require intensive

TABLE 5 - ARRAY OF PROJECT ALTERNATIVES
(See footnotes for Table 4)

| Alternatives | \$10,000 Funding Level | (\$000) | \$50,000 Funding Level | (\$000) | \$150,000 Funding Level | (\$000) | \$500,000 Funding Level | (\$000) |
|--------------|---------------------------|---------|---------------------------|---------|----------------------------|---------|----------------------------|---------|
| No Action | None | 0 | None | 0 | None | 0 | None | 0 |
| Minimal | 5 sq mi GP | 10 | 8 sq mi GP | 16. | 10 sq mi GP | 20 | 20 sq mi GP | 40 |
| | | | 2.8 sq mi CF | 17. | 5 sq mi CF | 30 | 10 sq mi CF | 60 |
| | | | 2 -- PR | 2. | 6 -- RD | 30 | 12 -- RD | 60 |
| | | | 3 -- RD | 15. | 4 -- PR | 4 | 8 -- PR | 8 |
| Low | | | | | 2 -- CD | 6 | 6 -- CD | 18 |
| | | | | | 1 -- DD | 60 | 5 -- DD | 300 |
| | | | | | | | 2.2 sq mi RS | 14 |
| | 1 sq mi RS & CB | 9.5 | 2 sq mi RS | 12.8 | 5 sq mi RS | 34. | 10 sq mi RS | 64 |
| | 1/4 sq mi GP | 0.5 | 1 sq mi CB | 3.2 | 2 sq mi CB | 6.4 | 2 sq mi CB | 6.4 |
| | | | 1 sq mi BC | 9.6 | 2 sq mi BC | 19.2 | 4 sq mi BC | 38.4 |
| | | | 3 mi D&D | 9.6 | 3 mi D&D | 9.6 | 10 mi D&D | 32 |
| | | | 1 sq mi GP | 2. | 10 mi T&S | 8. | 15 mi T&S | 12 |
| | | | 1 sq mi CF | 6. | 1/4 sq mi CAP | 1.6 | 1 sq mi CAP | 6.4 |
| | | | 8 1/2 mi T&S | 6.8 | 10 sq mi CF | 60 | 1 sq mi C&S | 22.4 |
| Moderate | | | | | 5.6 sq mi GP | 11.2 | 15 sq mi GP | 30 |
| | | | | | | | 20 sq mi CF | 120 |
| | | | | | | | 13 mi GW | 168.4 |
| | 2 3/4 sq mi GP | 5.4 | 4 sq mi GP | 8. | 6 sq mi GP | 12. | 20 sq mi GP | 20 |
| | 1/2 sq mi CF | 3. | 1 sq mi CF | 6 | 2 sq mi CF | 12 | 10 sq mi CF | 60 |
| | 1/4 sq mi CAP | 1.6 | 1 sq mi RS | 6.4 | 1 sq mi RS | 6.4 | 2 sq mi RS | 12.8 |
| | | | 5 -- RD | 25 | 10 -- RD | 50 | 10 -- RD | 50 |
| | | | 3 -- PR | 3 | 1 -- PR | 1 | 1 -- PR | 1 |
| | | | 1/4 sq mi CAP | 1.6 | 1 -- DD | 60 | 5 -- DD | 300 |
| | | | | | 1/2 sq mi BC | 4.8 | 2 sq mi BC | 19.2 |
| High | | | | | 2 3/4 mi T&S | 2.2 | 5 3/4 mi T&S | 4.6 |
| | | | | | 1/4 mi CAP | 1.6 | 1 sq mi CAP | 6.4 |
| | | | | | | | 2 mi GW | 26. |
| | 2 1/2 sq mi GP | 5. | 3 1/2 sq mi GP | 6.8 | 2 sq mi GP | 4 | 5 sq mi RS | 32 |
| | 1 -- RD | 5. | 1 mi D&D | 3.2 | 1/3 mi D&D | 1. | 5 sq mi BC | 48 |
| | | | 8 -- RD | 40 | 5 -- RD | 25 | 5 sq mi GP | 10 |
| | | | | | 2 -- DD | 120 | 4 -- PR | 4 |

resource management and coordination with users of the watershed to prevent destructive impacts to the soil resource. Trees and shrubs would be planted to enhance riparian stability.

5. High Action - Engineering Alternative

This alternative would recommend practical but expensive conservation treatments designed to attain the fastest response to achieve effective watershed stabilization. This alternative would seek immediate reduction of sedimentation to the Taylor Draw Reservoir and salinity control in the Colorado River. Large numbers of pit reservoirs, retention dams, drop structures, and stream channel riprap would be designed and built as quickly as funding and personnel levels allowed. Possibilities for large detention dams would be examined in cooperation with the Bureau of Reclamation or Army Corps of Engineers. Vegetation manipulations would be undertaken where structures were not practical. Greater recreational use would be likely because of the increased number of reservoirs and additional access.

Refer to Table 5, Array of Project Alternatives, for an estimate of work that could be done at the different funding levels.

C. Cost Estimates

Cost estimates for vegetation manipulations (Table 6) and engineered structures (Table 7) were obtained from the BLM, Division of Operations at the Craig District Office (1984). These costs are for planning purposes only.

Table 6 - Cost Estimates For Vegetation Manipulations

| <u>Vegetation Manipulation</u> | | |
|--------------------------------|-----------------------------|------------------|
| Burning sq. mile | \$3,200 per sq. mile | \$5.00 per acre |
| Sprayer sq. mile | \$8,000 plus material | \$12.50 per acre |
| Drilling sq. mile | \$4,480 plus material | 7.00 per acre |
| Contour Furrows | \$6,080 per sq. mile | 4.50 per acre |
| Assumption; 10' spacing | | |
| Plowing sq. mile | \$22,400 per sq. mile | 35.00 per acre |
| Brush Beating | \$9,600 per sq. mile | 15.00 per acre |
| Dikes and Diversions | \$3,200 per sq. mile | 5.00 per acre |
| Seed | \$6,400-25,600 per sq. mile | 10-40 per acre |
| Tree & shrub planting | \$800 per bank mile | |
| Critical Area Planting | \$6,400 per sq. mile | |
| Grassed water ways | \$13,000 per mile | |

V. Feasibility Analysis

An excellent discussion on salinity project feasibility is given in Salinity Guidance, a document put together by the Denver Service Center. It is included here to be applied to all future projects in the Lower Wolf Creek Watershed.

TABLE 7 - SAMPLE PROJECT BENEFIT-COST DATA

| Treatment | Cost | Structures per sq. mile | Life of project | Sediment Storage Capacity | Tons of salt Retention | Retention Benefit | B/C <u>7/</u> Ratio |
|----------------|-----------------------------|----------------------------|--------------------|------------------------------|---------------------------|----------------------|------------------------|
| Contour furrow | \$6,090 per sq mi <u>1/</u> | 10' spacing | 10 <u>2/</u> | 24,320 T/sq mi <u>2/</u> | 730 T/sq mi | \$41,318 | 6.795 |
| Gully Plug | \$2,000 per sq mi <u>3/</u> | 2,240 <u>2/</u> | 15 <u>2/</u> | 17,280 T/sq mi <u>2/</u> | 518 T/sq mi | \$29,340 | 1.468 |
| Pit Reservoir | \$1,000 ea. <u>3/</u> | 8 | 25 <u>4/</u> | .25 ac/ft | 12.1 T | \$685 | .685 |
| Check Dam | \$1,550 ea. <u>5/</u> | 8 | 25 <u>4/</u> | .1 ac/ft | 4.8 T | \$274 | .304 |
| Retention Dam | \$5,000 <u>3/</u> | 5 | 25 <u>4/</u> | 3.35 ac/ft | 162 T | \$9,169 | 1.833 |
| Dentention Dam | \$60,000 <u>6/</u> | 0.3 | 50 <u>4/</u> | 40 ac/ft | 1,938 T | 109,700 | 1.828 |

1/ Calculated from \$35/hr tractor and operator traveling 4 mph on 10' spacing.
2/ Gifford 1975.

3/ Taken from 1983 contract in WRRRA bulldozer cost \$75/hour.

4/ BLM Manual 7422 Water Control Structures.

5/ Data from the 1981 WRRRA Reservoir Contract.

6/ Data from the 1983 KRA Spring Creek Contract.

7/ Interest rate equals 13%.

Conversion Factors:

One acre foot of sediment equals 1,615 tons

3% sediment from Mancos Shale equals the weight of salt

1 Ton of salt retained equals \$56.60 benefit downstream

A. Salinity Guidance

Three major characteristics of potential salinity projects are:

1. The project area has natural characteristics which make it a major contributor of salt and sediment by surface runoff and erosion.
2. Surface runoff and erosion rates are accelerated, in part, because of past management practices and can be reduced by proper watershed management.
3. Watershed management activities will complement range planning by providing water onsite for increased forage production or livestock use and will decrease downstream flood peaks, channel erosion, and sediment transport.

Strictly from a salt reduction standpoint, steep dissected shale badlands contribute considerably higher amounts of sediment and salt than low relief shale lowlands. Work done by Jackson and Julander, using simulated rainfall, measured suspended sediment concentrations; electrical conductivities were 180 and 68 times greater, respectively, for steep dissected Mancos shale uplands than for a low relief shale sediment and recent alluvial surfaces. The main objective in salinity control is to prevent runoff/sediment/salt from occurring in areas which have high saline soils that are experiencing accelerated rates of erosion.

The type of projects considered include small and large retention structures (including stock water ponds), pits, plugs, and contour furrows. A combination of the above projects is used. The retention structures probably benefit range and wildlife activities the most. A series of small gully plugs are probably the most desirable from the salinity control viewpoint because they are inexpensive and can be placed almost anywhere.

B. Types of Controls

Four types of salinity control situation could be considered on BLM lands. These include:

1. Perennial flow from slightly saline cliffs and uplands which then traverses saline lowland formations both as channel flow and groundwater.
2. Gullies being cut in saline shale sediments.
3. Surface erosion from steep shale badland formations.
4. Saline groundwater springs.

The control of salts from items 1 and 4 above requires major engineering work, and are expensive to implement. Projects would concentrate therefore, on gully control and surface erosion. These two types of control are to reduce active erosion and the corresponding salt yields. Increased vegetation cover is the desired end product but, in many areas where precipitation and salt content are the limiting factors, the retention of runoff via structural techniques is required.

Because the source of salts from gully systems is associated with bed and bank materials, gully control can be effective only if it arrests an active process of gully deepening or headward advance. A gully control structure for salinity control works only by stabilizing gullies and eliminating salt contributions from bed and bank materials. The structures do not serve to effectively trap large quantities of salts. Therefore, many gully systems which are no longer active are not amenable to management for salinity control even though other watershed benefits may be derived by healing gullies.

Once an active gully system is identified, the process of degradation can be reversed by artificially raising the level of a gully bottom at its mouth and by protecting nick points throughout the gully system. Active gully formation can also be reversed by preventing runoff from entering the system.

Gully restoration can be accomplished by properly constructing large structures, beginning at the lower end of a gully system causing sediment to be deposited behind these structures. A gully plug should be constructed low enough in the gully to allow flash floods to overtop the dam. Dams can be constructed from compacted earth fill or rock if available. An excellent reference for plug specifications, spacing, and construction is Heede, B.H. 1976. Gully Development and Control: The Status of Our Knowledge, USDA, Forest Service Research Paper RM-169, Fort Collins, Colorado.

Headcuts can also be controlled by gully plugs. Headcut control structures should be porous to eliminate the need for large heavy structural foundations. The structure should be located slightly downstream from the headcut. The headcut wall should be sloughed to such an angle that material will be deposited in layers of increasing particle size. The objective is to reduce the headcut wall to a gentle slope. Revegetation of the new slope is vital.

Measures taken outside the channel can also aid in reduction of salts. Improvements to the watershed that increase infiltration/reduce overland flow, and spread (instead of concentrating runoff) will reduce salt yields. The prevention of runoff from saline soil is the objective here.

C. Determining Cost Effectiveness

Public Law 92-500, Clean Water Act of 1972, states that salinity standards must be met. From a national perspective, the rating of salinity control projects for participants (USBR, SCS, Basin States, BLM), is done on a cost comparison basis known as cost-effectiveness.

This comparison has been developed in lieu of a benefit-cost (B-C) ratio because most of the major salinity control projects being conducted by USBR and SCS have a low B-C ratios. In contrast, the small projects proposed by the BLM are very cost-effective, per ton of salt removed, and are favorite projects of the Colorado River Salinity Control Forum.

A dollar loss has been placed on salt concentration, as measured in milligrams per liter, at Imperial Dam. This value changes every year and currently is \$566,600 per 1 mg/l for projects above Parker Dam. Converting to tons, approximately 10,000 tons of salt being contributed from Colorado is equivalent to 1 mg/l as measured at Imperial Dam. Thus, a reduction of 10,000 tons of salt from BLM lands in Colorado per year has a dollar benefit of \$566,600 for that year. This works out to \$56.66 per ton of salt. It becomes apparent that the reduction of a ton of salt at a benefit of \$56.66 per ton has a much greater benefit than an increase in 1 AUM at \$1.37.

This above economic summary is useful for establishing benefits, but for project ranking the following method can be used:

Two parameters must be known before salinity benefits/cost-effectiveness can be determined. These parameters are:

- 1) Salt concentration tons/year
- 2) Annual water yield (Acre-feet/year)

Salt concentrations can be obtained by Saturation Extract. Several extracts should be taken throughout the area to be treated, then averaged for a representative number. Measurements should be taken in micromhos/cm. An approximate conversion to total dissolved solids (TDS) in mg/l from micromhos/cm can be estimated by multiplying the micromhos/cm by 0.65 to get TDS in mg/l.

The formula for the conversion of salt concentrations from TDS in mg/l to tons/acre-feet is:

$$S \text{ (tons/acre-feet)} = 0.00136 \text{ TDS}$$

Water yield may be determined either by SCS curve number, extrapolation of gaging station information in the area, or USGS water supply paper 2193. Yields should be in acre-feet/year. The conversion for this is $Qt = 724 \times Q$, where Q is mean annual discharge in cfs.

To determine the total salt yield, multiply salt concentration (S , tons/acre-feet) times total water yield (Qt , acre-feet/year). This gives tons of salt/year from which benefits can be claimed.

If a person is unable to determine concentrations via saturation extract, work done on Mancos shale in Badger Wash indicates that salt concentrations in the soil average about 3.8 percent by weight. Thus, if sediment yields are known, salt yields can be estimated as 3.8 percent of sediment yields.

Projects should be ranked according to both salt reduction, and range/wildlife needs.

Construction feasibilities and risk analysis will be done according to appropriate BLM Manual Sections and Technical Note 337, Hydrologic Risk and Return Period Selection for Water Related Projects.

D. Methods of Estimating Direct Runoff from Rainfall

Many methods have been developed for estimating runoff from strong rainfall on ungaged drainage basins. Because most BLM basins are ungaged, one of these methods must be selected, utilizing available watershed data other than gaged runoff data from the area. In addition, methods which predict the changes in runoff characteristics resulting from changes in land use, hydrologic condition, and watershed cover, or from application of land treatments, are desirable. To meet these needs, the Soil Conservation Service method, which uses a rainfall-runoff relation with runoff curve numbers (CN), was selected as the preferred method, although other methods will be implemented as needed.

The curve number method incorporates basin area, channel length, basin relief, channel slope, cover classes, and hydrologic soil groups. Cover classes are determined by existing vegetation types, whereas hydrologic soil crops are determined by soil survey data incorporating infiltration rates, soil textures, and permeability.

VI. Monitoring and Studies

The purpose of this monitoring is to quantify changes in selected parameters and effectiveness of proposed projects on reducing the amount of sediment and salinity leaving the watershed.

Objectives include: (a) Develop a monitoring network for the Lower Wolf Creek area to quantify watershed inputs and outputs. (This is important since very little data presently exists.) (b) Monitor the effectiveness of the various treatments, i.e. vegetational or structural, at the treatment site by comparing with untreated areas.

A. Measuring Inputs and Outputs from the Lower Wolf Creek Watershed Area

There are three proposed levels of monitoring (Table 8) for the first year of implementation of this WMP. Monitoring levels reflect different methods of obtaining access to the study area and of data collection. Higher costs at Levels B and C reflect additional equipment, helicopter, and construction costs. Intense monitoring should be followed for at least three consecutive years following establishment of the stations. After this initial three year period, yearly monitoring should be confined to essential parameters. (Essential parameters would be determined by the three years of monitoring.) Disregarding the initial equipment and installation charges during the first year, the major expense will be helicopter funding. Helicopter support is necessary to allow early access in the

spring and immediately following the major summer storm events. All costs are estimates of maximum needs, and are dependent on the amount of helicopter time used.

Monitoring Level A (No Helicopter). This level supplies minimal data, i.e. the events occurred. Major runoffs and summer storms would be missed. Major limiting factors are environmental conditions. Both costs and information gained are low. Estimated costs for the first year are \$6,100 and costs for the following years at this level are \$2,400 per year.

Monitoring Level B (Moderate Helicopter Support and Increased Instrumentation). Data obtained at this level would include total precipitation, stream discharge during spring runoff and peak flows, and limited salinity and sediment data. Helicopter funding would allow access during spring and summer events. Estimated maximum costs for the first year is \$18,500 and costs for the following years at this level are \$8,400 per year which reflects additional helicopter funding over Level A.

Monitoring Level C (Highest Level of Helicopter and Instrumentation). This level supplies the best data and access. Access would be on an as needed basis due to additional helicopter funding. Parameters measured at this level are snow depth, suspended sediments, discharge, storm occurrences, duration, and intensity, and peak flows. This level would measure major inputs and outputs into the watershed. Estimated costs for the first year are \$31,500 and costs for the following years at this level are \$12,400 per year (\$10,000 for helicopter is included). Workmonths needed for monitoring at all levels are approximately the same, however, due to increases in the helicopter funding more time is spent on the ground instead of travel at Levels B and C.

Proposed Monitoring Level. The first three years of monitoring would be at Level C. Total estimated costs includes \$31,500 for the first year and \$12,400 for each additional year. After this three year period, the monitoring costs would drop to between \$6,400 and \$8,400 depending on parameters monitored and the amount of helicopter funding used.

B. Possible Studies for Determining the Effectiveness of Various Projects on Reducing Both Sediment and Salinity Yields in the Treatment Areas.

A Prerequisite to any Monitoring Plan is an Intensive Inventory of Specific Project Sites. The type of study or monitoring needed to determine the success of treatments will be on an individual treatment basis. Possible methods include:

1. Measuring sediment and/or flows from the upper and lower ends of a dike system. To determine if the system is spreading or concentrating flows. Paired areas, one watershed with and one without a spreader system, could be compared.
1. Retention dams, gully plugs, check dams, and ponds. These small structures can be tested as paired treatments by placing

structures in and out of the various treatment area and comparing amount of sediment retained, peak flows from drainages, and/or changes in downstream characteristics. If total sediment retained is going to be looked at then, the structures have to be of a size that would insure that they would be dry by late summer or establishing a small erosion plots. Possible methods would be to construct some structures approximately 36 inches in depth and located in small watersheds (Table 9). Possible watershed and structures sizes are given below.

Table 9 - Possible Watershed and Structure Sizes

| <u>Watershed Size (acres)</u> | <u>Runoff (inches)</u> | <u>Acre inches</u> | <u>Estimated Pond Size (in ac. ft)</u> | <u>Estimated size of a square acre 3 feet in depth</u> |
|-----------------------------------|----------------------------|------------------------|--|--|
| 1 | .5 | 0.5 | 0.042 | 25 x 25' |
| 2 | .5 | 1.0 | 0.083 | 35 x 35' |
| 5 | .5 | 2.5 | 0.208 | 55 x 55' |
| 10 | .5 | 5.0 | 0.416 | 77 x 77' |

3. Seeding, burns and brush beating. Monitoring of these sites would include a pretreatment inventory to determine vegetative cover and frequency, and degree of erosion prior to treatment. Coupled with this pretreatment, inventory monitoring sites would be selected. Following treatment monitoring sites would be established both in and outside the treatment area. Possible methods would include establishment of USLE Plots.

USLE Plots Plot Size: 73' x 6' 438 ft²
Number of Plots: 3 per treatment
Estimated Annual Discharge: 17.9 cf or 135 gal.
Catchment Sizes:
 Half cylinder 3.25' in dia. by 6' in length
 Rectangular 2'x 6'
 Cylinder 6' in dia. by 0.8' in height
Fence: 240 linear feet approx. \$70.00
Estimated Cost (total): \$200

4. Paired watershed studies.
5. Paired stream studies with stations both up and downstream from the study area (refer to Figure 7).

Workmonths Needed

Approximately two wm's are needed for construction of the monitoring sites or studies. This would be conducted by BLM Division of Operations and/or by contract.

Monitoring would take one wm's from the District and/or Area Hydrologist, and/or Soil Scientists.

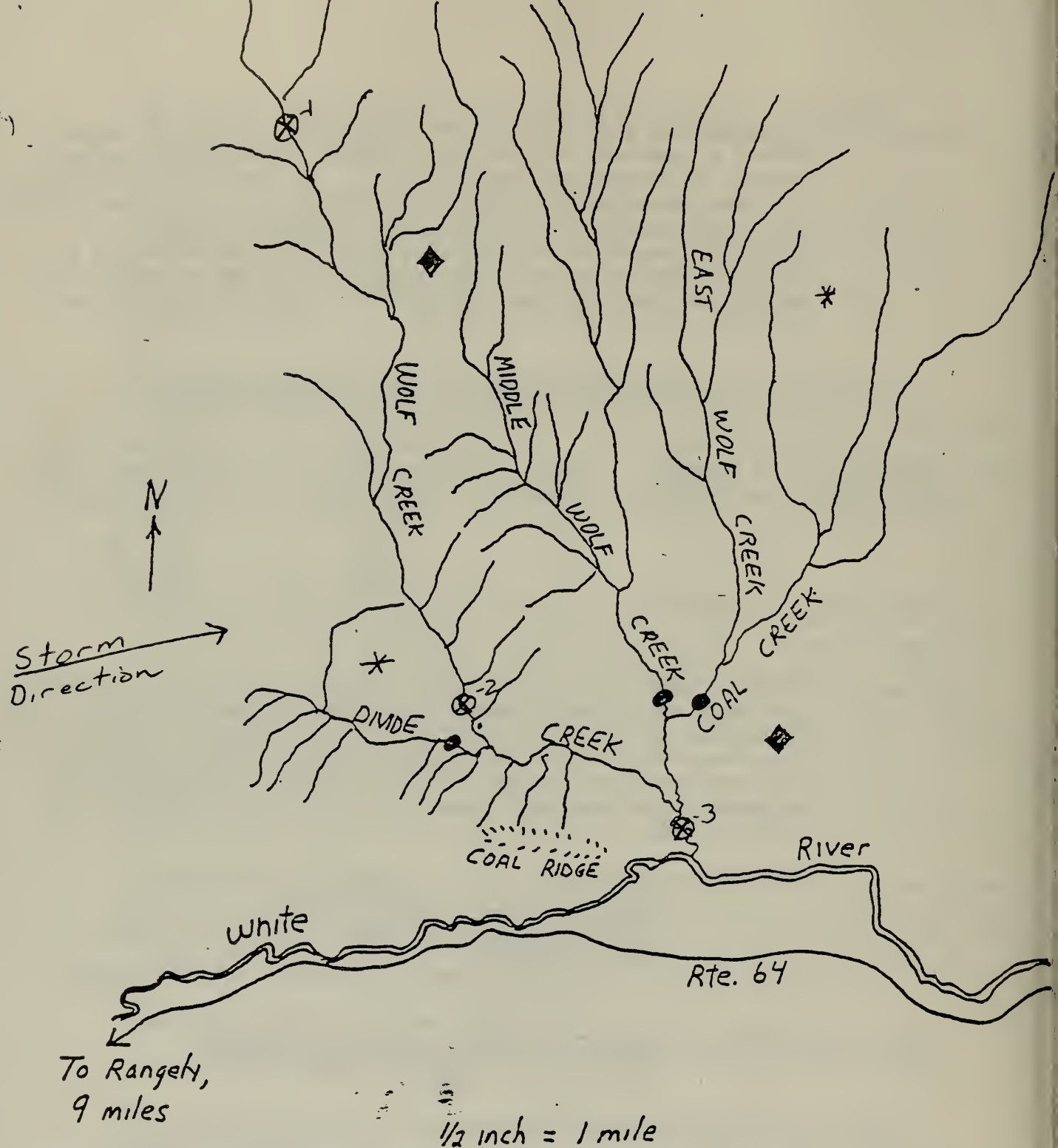


Figure 7 Lower Wolf Creek Watershed
MONITORING SITE LOCATION MAP

Legend

- ⊗ Automatic Sediment sampler and Stevens Flood water level recorder
- Stevens water level recorder
- * Recording Raingages
- ◆ Storage Raingages

VII. Consultation and Coordination

All proposed range improvements, treatments, vegetation manipulations, and future AMP modifications dictated by this WMP will be coordinated with all resources affected, with the permittee, and with state and federal agencies where applicable. Implementation of this WMP will be in conformance with resource objectives as stated in the land use plan for the White River Resource Area.

1. USDA, Soil Conservation Service - Alvin Jones
2. Upper Colorado Environmental Plant Center - Sam Stranathan
3. County Commissioners, Rio Blanco County, Colorado - Kenneth Kenny
4. County Commissioners, Moffat County, Colorado
5. Colorado State Water Engineer Office
6. USDI, Bureau of Reclamation
7. Colorado Division of Wildlife - Tom Lines
8. Rangely Water Users Association
9. Colorado River Salinity Control Forum
10. Grazing Advisory Board
11. District Managers Advisory Board
12. Livestock Permittees, will be consulted as site-specific projects are located in their grazing allotments (see Table 10).

TABLE 10 - LIVESTOCK PERMITTEES

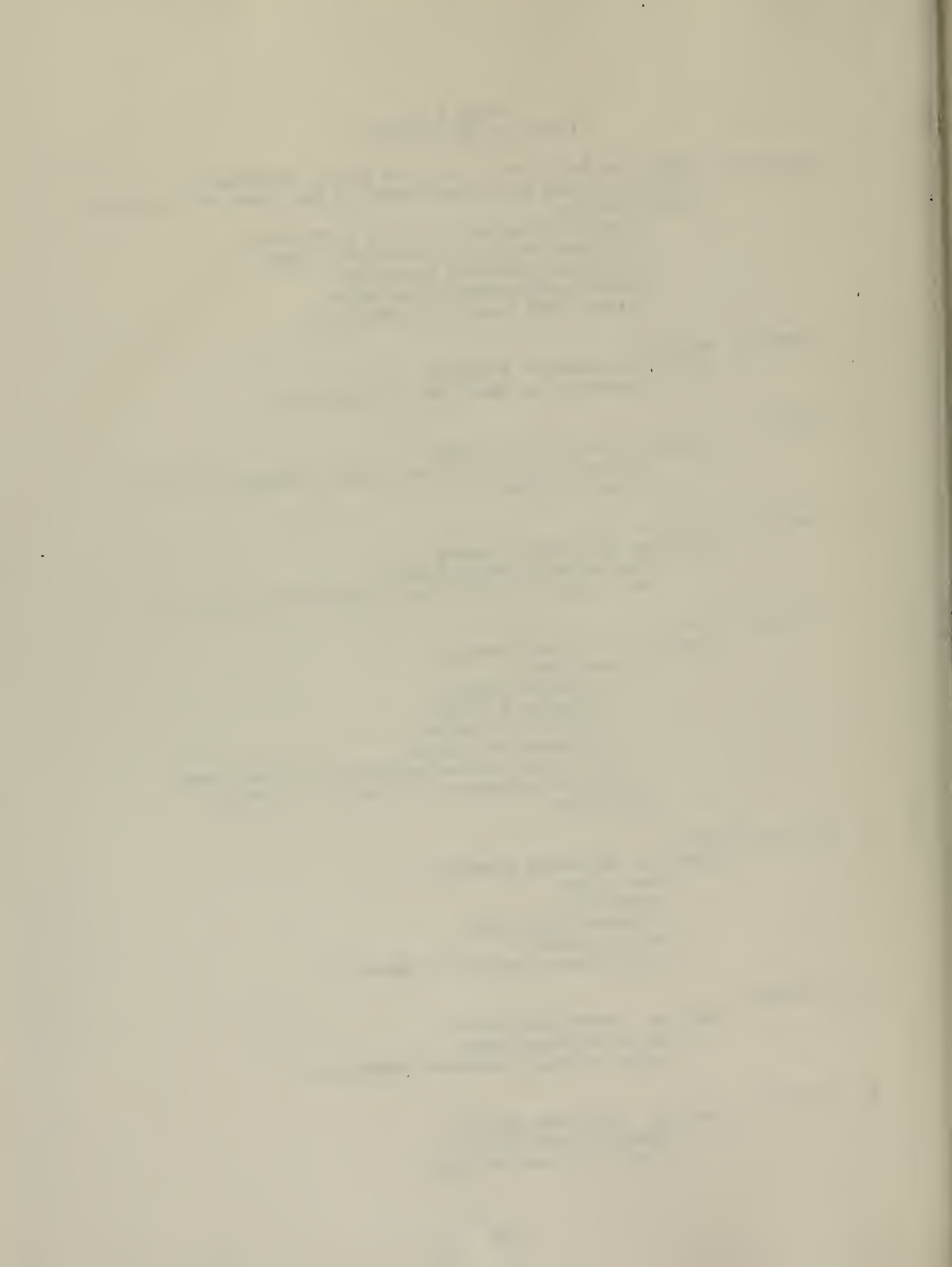
| <u>Allotment</u> | <u>No.</u> | <u>Name</u> | <u>Permittee</u> |
|------------------|------------------|-------------|--|
| 6324 | Massadona | | Nick Mahleres and Minford Beard, Three Springs Ranch |
| 6334 | Coal Reef | | Livingston and Dunn |
| 6332 | Horse Draw | | Harv Wyman |
| 6331 | Baking Powder | | Clair Villard |
| 6333 | Pinyon Ridge | | Dale Weldon, Yellow Creek Ranch |
| 6330 | Upper Coal Crk | | Bogle Farms |
| 6329 | Winter Valley G1 | | Livingston and Dunn |
| 6326 | Elk Springs | | Halbert Tuttle |
| 6323 | Wolf Creek | | Minford Beard, Three Springs Ranch |

VIII. APPENDICES

- A. Legend to Map Overlays
- B. Geologic Column Summary
- C. Soil Occurring in Lower Wolf Creek
- D. Water Resource Data Summary
- E. Existing Watershed Project List
- F. Existing Vegetation Manipulations (reserved)
- G. Range Sites Occurring in Lower Wolf Creek
- H. Plant Species Names
- I. Types of Structures and Vegetation Manipulations Planned

APPENDIX A
LEGEND TO MAP OVERLAYS

1. Base Map - Moffat and Rio Blanco County Map Series (Topographic, 1:50,000) United States Department of the Interior, Geological Survey Contains:
 - Watershed Boundary of entire Wolf Creek
 - Watershed Boundary of Lower Wolf Creek
 - State Land Ownership Boundaries
 - Public Land Ownership Boundaries
 - Private Land Ownership Boundaries
2. Surficial Geology
 - Contains: Watershed Boundary
 - Formations as described in Appendix B
3. Soils
 - Contains: Watershed Boundary
 - Soil Mapping Units as described in Section III F and listed in Appendix C
4. Erosion Potentials
 - Contains: Watershed Boundary
 - Erosion Map (Tons/Acre/Year)
 - See Sediment yield in Soils narrative Section III F
5. Treatment Units
 - Contains: Watershed Boundary
 - Treatment Units
 1. Mancos Uplands
 2. Mancos Alluvium
 3. Gullied Alluvium
 4. Sagebrush Uplands
 5. Pinyon-Juniper Woodlands and steep slopes
 - See Project Implementation Section for further discription
6. Existing Projects
 - Contains: Watershed Boundary
 - Fence Lines
 - Reservoirs
 - Allotment Boundaries
 - Project Numbers
 - For complete listing see Appendix G
7. Hydrology
 - Contains: Watershed Boundary
 - Stream Drainage Orders
 - Major Tributary Watershed Boundaries
8. Cultural
 - Contains: Watershed Boundary
 - Known Cultural Sites
 - Class III Inventory Sites



APPENDIX B
GEOLOGIC COLUMN SUMMARY

I. Quaternary

Alluvium and Colluvium - Qac

Silt, sand and gravel along tributary streams and floodplains along Wolf Creek.

Gravel - Og

Caps probable pediment surfaces south of Elk Springs Ridge; thickness ranges from thin veneer to a few feet.

Landslide Deposits - Ql

Coherent glide blocks to heterogeneous mixtures of angular rock fragments; includes some slope wash along south slope of Elk Springs Ridge.

II. Tertiary

Brown's Park Formation - Tbp

Light gray to white fine to medium grained soft friable crossbedded sandstone containing small amounts of conglomerate; basal part is conglomerate consisting of poorly lithified pebbles, cobbles, and boulders of limestone, dolomite, chert, and lesser amounts of red conglomeratic sandstone; 0 to about 135 feet thick but averages between 40 and 90 feet because of erosion.

III. Cretaceous

William's Fork Formation - Kwf

Interbedded buff sandstone, gray shale, brown carbonaceous shale, and coal beds as much as 10 feet thick; contains much poorly exposed shale in middle part; about 2,500 to 2,900 feet thick.

Iles Formation - Kit and Ki

Interbedded buff fine grained sandstone, gray shale, brown carbonaceous shale, and a few thin beds of coal about 1,100 feet thick.

Kit - Trout Creek sandstone member, whitish-gray fine grained crossbedded sandstone; ranges from 0 to more than 100 feet in thickness.

Ki - Main body.

Mancos Shale - Km and Kmu

Kmu, upper unit; dark gray partly sandy marine shale containing a few zones of limestone concretions; about 450 feet thick. Io, base of

Loyd Sandstone Member. Member is gray very fine grained sandstone containing large spheroidal limy concretions and many invertebrate marine fossils, ranges from 0 to about 50 feet in thickness and occurs about 75 to 100 feet below top. C, base of sandstone unit C. Unit is light yellowish-brown and whitish-gray very fine to fine grained shaley sandstone ranging from a few feet to about 75 feet in thickness; occurs at base.

Km, main body: chiefly dark gray marine shale; about 5,100 feet thick. b, base of sandstone unit B. Unit is lithologically similar to sandstone unit C above but ranges from 0 to about 35 feet in thickness; occurs about 160 feet below top.

Mancos Shale - Kfd

Frontier Sandstone Member: upper part is interbedded gray and tan fossiliferous calcareous sandstone and gray shale; lower part is soft brownish-gray shale containing thin beds of bentonite; about 200 feet thick.

Mowry Shale Member: gray siliceous shale interbedded with many thin beds of bentonite; contains many fish scales and bones; weathers to distinctive light ash gray; about 100 feet thick.

Dakota Sandstone: Upper part is light gray quartzitic sandstone containing dark chert pebbles and a few thin beds of dark gray shale; middle part is chiefly dark gray fissile shale; lower part, locally absent, is light gray sandstone containing dark chert pebbles; thickness of formation ranges widely but generally is about 70 to 100 feet.

IV. Jurassic

Morrison Formation - Jmce

Interbedded varicolored siltstone and claystone, light gray sandstone and some chert pebble conglomerate; a few lenticular beds of nodular limestone near top; whitish-gray massive very fine to fine grained sandstone ranging from 25 to as much as 130 feet in thickness at base; about 600 feet thick.

Curtis Formation - Jmce

Interbedded sandstone, shale and oolitic limestone; predominantly olive gray and greenish-gray; glauconitic and fossiliferous; about 100 feet thick.

V. Triassic

Entrada Sandstone - Jmce, Glen Canyon Sandstone - JTrg

Grayish-orange very fine to fine grained crossbedded sandstone; about 700 to 800 feet thick; scattered chert pebbles in thin zone 50 to 75 feet below top may mark vestigial edge of Carmel Formation which separates the two sandstones.

Chinle Formation - TrPcp

Interbedded siltstone, claystone, shale, and locally conglomeratic sandstone; includes a few beds of distinctive siltstone and mudstone-pebble conglomerate; varicolored red, gray, green, and yellow, but overall color is reddish-brown; distinctively colored ocher siltstone member about 65 feet above base, consists of 20 feet of dusky yellow claystone and minor amounts of red shale and siltstone; about 285 feet thick.

VI. Permian

Meonkopi and Park City Formations - TrPcp

Chiefly reddish-brown siltstone and shale; partly sandy and gypsiferous; lower 150 feet (Park City Formation) consists chiefly of yellowish- and brownish-gray calcareous siltstone with a distinctive thin yellow phosphatic dolomite bed at top; about 700 feet thick.

VII. Carboniferous

Weber Sandstone - PPw

Grayish-orange very fine to fine grained crossbedded sandstone; estimated thickness about 800 feet. Shown only in cross sections.

Morgan Formation - Pm

Interbedded gray fossiliferous cherty limestone, buff crossbedded sandstone, and lesser amounts of gray, red, and green shale; estimated total thickness about 1,000 feet.

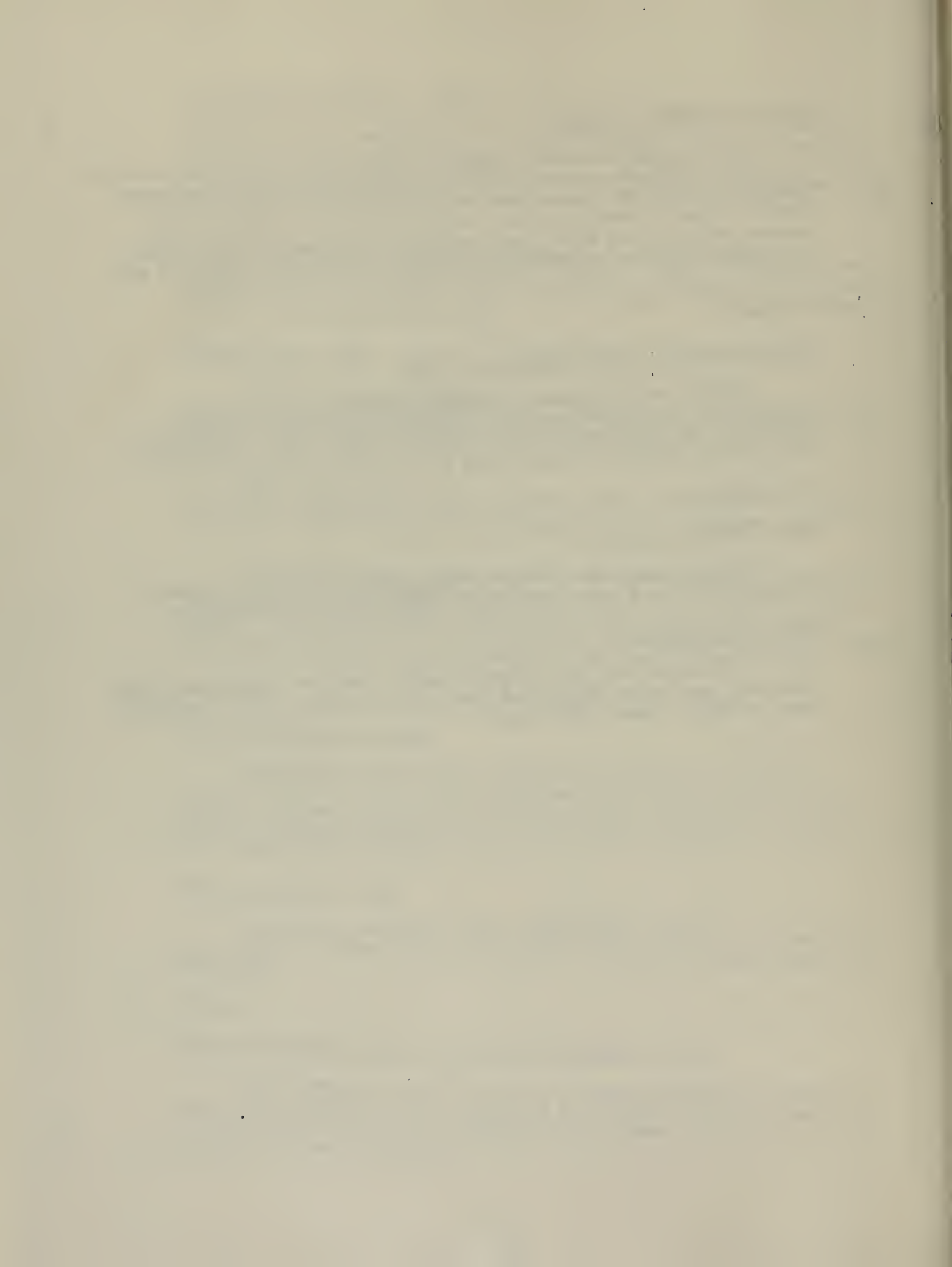


TABLE 11 - SOILS OCCURRING IN LOWER WOLF CREEK
Rio Blanco Mapping Units

| <u>Number</u> | <u>Mapping Unit Name</u> | <u>Slope</u> | <u>Range Site</u> | <u>Treatment Unit</u> |
|---------------|--|--------------|-------------------|-----------------------|
| 5 | Badlands (steep Mancos) | | No Site | 5 |
| 7 | Billings silty clay loam (Drainages on Mancos) | 0-5% | Alkaline Slopes | 2 |
| *8 | Billings-Torrifluents Complex Gullied (Drainages on Mancos) Alluvium | 0-5% | Alkaline Slopes | 2 |
| *17 | Chipeta silty clay loam (Mancos) | 3-25% | Clayey Saltdesert | 1 |
| *18 | Chipeta-Killpack silty clay loams (Mancos) | 3-15% | Clayey Saltdesert | 1 |
| 20 | Clayburn loam | 3-15% | Mountain Loam | 4 |
| 21 | Cliffdown-Cliffdown Var. Complex | 5-65% | Saltdesert Breaks | 1 |
| 31 | Dollard silty clay loam | 15-40% | Clayey Foothills | 1 |
| 33 | Forelle loam | 3-8% | Rolling Loam | 4 |
| 53 | Moyerson stony clay loam | 15-65% | Clayey Slopes | 1 |
| 73 | Rentsac channery loam | 5-50% | P-J Woodland | 5 |
| 74 | Rentsac-Moyerson-RO Complex | 5-65% | P-J Woodland | 5 |
| 78 | Rock Outcrop | | P-J RO complex | 5 |
| *90 | Torrifluents, Gullied | | No Site | 3 |
| *91 | Torriorthents-RO Complex | 15-90% | Stony Foothills | 5 |
| 93 | Turley fine sandy loam | 0-3% | Alkaline Slopes | 2 |
| 94 | Turley fine sandy loam | 3-8% | Alkaline Slopes | 2 |
| 95 | Uffens loam | 0-5% | Alkaline Slopes | 2 |

Moffat County Mapping Units

| <u>Number</u> | <u>Mapping Unit Name</u> | <u>Slope</u> | <u>Range Site</u> | <u>Treatment Unit</u> |
|---------------|----------------------------------|--------------|------------------------------|-----------------------|
| 03B | Havre fine sandy loam (Wetlands) | 0-5% | Foothills Swale | 2 |
| 4E | Abor silty clay loam | 12-25% | Clayey Foothills | 1 |
| 04A | Glendive loam | 0-3% | Foothills Swale | 2 |
| 05 | Panitchen sandy loam | 0-3% | Foothills Swale | 2 |
| 9E | Moyerson-Rentsac Complex | 5-45% | Clayey Slopes/Pinyon-Juniper | 5 |
| X9E | Grieves-Yamac-Crestman Assoc. | 3-45% | PJ/?/PJ | 5 |
| 11E | Rentsac-Moyerson+R0 Complex | 25-65% | Pinyon-Juniper/Clayey Slopes | 5 |
| 12D (Mancos) | Kinnear loam | 1-5% | Loamy Saltdesert | 1 |
| 13C | Unnamed loamy sand | 0-12% | Sandy Foothills | 4 |
| 17E | Work loam | 12-25% | Mountain Loam | 4 |
| 23D | Cruckton loamy sand | 5-15% | Sandy Foothills | 4 |
| 23E | Cruckton loamy sand | 15-30% | Deep Loam | 4 |
| 26D | Berlake sandy loam | 3-12% | Sandy Foothills | 4 |
| 28D | Forelle loam | 3-12% | Rolling Loam | 4 |
| 28E | Forelle loam | 12-25% | Rolling Loam | 4 |
| 32D | Yamac loam | 5-15% | Clayey Foothills | 1 |
| 32E | Yamac loam | 15-30% | Clayey Foothills | 1 |
| 33D | Pinelli loam | 3-12% | Clayey Foothills | 1 |
| 39C | Hereford sandy loam | | | |

| <u>Number</u> | <u>Mapping Unit Name</u> | <u>Slope</u> | <u>Range Site</u> | <u>Treatment Unit</u> |
|---------------|--|--------------|--------------------------------|-----------------------|
| 54X | Yetull Gravelly - Zeona Complex | 5-30% | Loamy Breaks/Sandhills | 4 |
| 56 | Zeona loamy sand | 3-12% | Sandhills | 4 |
| 58D | Bulkley silty clay loam | 3-12% | Clayey Foothills | 1 |
| 58E | Bulkely silty clay loam | 12-25% | Clayey Foothills | 1 |
| 62D | Rock River sandy loam | 3-12% | Rolling Loam | 4 |
| 63D | Grieves loamy find sand | 3-12% | Sandy Foothills | 4 |
| 64D | Forelle-Evanston loams | 3-12% | Rolling Loam/Deep Loam | 4 |
| 88F | Terada Variant cobbly sandy loam | 25-65% | Gravelly 7-14" | 4 |
| 91 | Glenton loamy fine sand (Major Bottoms) | 1-6% | Salt desert Overflow | 3 |
| 92 | Almy very fine sandy loam | 3-15% | Rolling Loam | 4 |
| 93 | Begay loamy fine sand | 3-15% | Sandy Salt desert | 1 |
| 101 | Torriorthents-R0 Complex | Very Steep | No Site | 5 |
| 105 | Kemmerer-Moyerson silty clay loams | 20-40% | Clayey Slopes | 1 |
| 110E | Kemmerer silty clay loams | 12-25% | Clayey Slopes | 1 |
| X110 | Kemmerer-Yamac Complex | 5-30% | Clayey Slopes/Clayey Foothills | 1 |
| 115 | Yetull-Crestman loamy sands | 20-50% | Sandy Foothills/Loamy Breaks | 4 |
| 116 | Grieves-Crestman-Cushool Complex | 10-40% | Pinyon-Juniper | 5 |
| *X121 | Deaver-Chipeta silty clay loams (Mancos Uplands) | 3-35% | Clayey Salt desert | 1 |
| 122 | Schooner - R0 Complex | 5-45% | Pinyon-Juniper | 5 |

Moffat County Mapping Unit (Continued)

| <u>Number</u> | <u>Mapping Unit Name</u> | <u>Slope</u> | <u>Range Site</u> | <u>Treatment Unit</u> |
|---------------|--|--------------|--|-----------------------|
| X122 | Schooner-Mespun loamy sands (swales) | 5-25% | Pinyon-Juniper/Semi-desert Sandy Loam | 5 |
| 123 | Natrargids (Mancos Sideslopes) | 0-5% | Salt desert Overflow | 2 |
| 124 | Spool-Unnamed loamy fine sands | 5-40% | Sandy Foothills | 4 |
| 132 | Torriorthents/Torripsamments | Mod. Steep | Juniper Woodland | 5 |
| *133 | Torriorthents-R0 Shale Complex (Mancos Ridgetops) | 25-65% | Clayey Salt desert | 1 |
| *138 | Notal Var. silty clay loam (Mancos Sidedraws) Alluvium | 0-12% | Alkaline Slopes (297) | 2 |
| 142 | Brownsto-Luhon Complex | 3-25% | Loamy 10-14" | 4 |
| 147 | Niart-Brownsto Var. Garza Var. Complex | 15-45% | Dry Mountain Loam/Dry Exposure/Mountain Loam | 4 |
| 149 | Kemmerer-Tridell Var. Complex | 15-65% | Juniper Woodland | 5 |
| *200 (Mancos) | Silli-Panitchen loam | 1-8% | Semi-desert Clay Loam/Foothills Swale | 2 |
| *201 (Mancos) | Unnamed A-Unnamed B Complex | 3-20% | Semi-desert loam/Clayey Slopes | 1 |
| *202 (Mancos) | Deaver-Michey Complex | 5-45% | Clayey Slopes/Semi-desert Loam | 1 |
| RG | Gullied Land | | No Site | 3 |
| RL | Rockoutcrop-Torriorthents Complex | 25-40 | Juniper Woodland | 5 |

TABLE 12 - WATER RESOURCE DATA SUMMARY

| Proj No | Name | Legal Description | | | Allotment | | RA | PU | Map Code | TP | Spec Cond | Flow GPM | Date Measured | Condition/ Maintenance/Reliability | |
|------------|----------------------|-------------------|-----|-----|-----------|------|----|----|-------------|-----|--------------|-------------|------------------|---------------------------------------|--|
| | | Qtr | Sec | Twp | Rng | No. | | | | | | | | | |
| 4555 | Orange Spring | NENE | 9 | 4N | 98W | 6326 | 68 | 07 | 108-21 | S | 2226 | Seep | 6/21/82 | /Perennial | |
| | Elk Springs | NWSE | 33 | 5N | 98W | 6329 | 68 | 07 | 108-10 | R-S | 6440 | Seep | 8/18/81 | G-N/Perennial | |
| | Elk Springs | NWSE | 33 | 5N | 98W | 6329 | 68 | 07 | 108-10 | S | 4012 | 0.13 | 7/1/82 | R/A/Perennial | |
| | Horse Draw Well | SWNE | 3 | 3N | 100W | 6324 | 68 | 07 | 110-04 | S | 372 | 14.12 | 6/28/83 | Perennial | |
| | Wild Horse Spring & | SESE | 23 | 3N | 100W | 6335 | 68 | 07 | 119-43 | S | -- | -- | 9/13/83 | Seasonal | |
| | Wolf Crk Div. Dam #1 | NESE | 19 | 4N | 99W | 6326 | 68 | 07 | 110-01 | S/R | 2141 | -- | 7/6/83 | Perennial | |

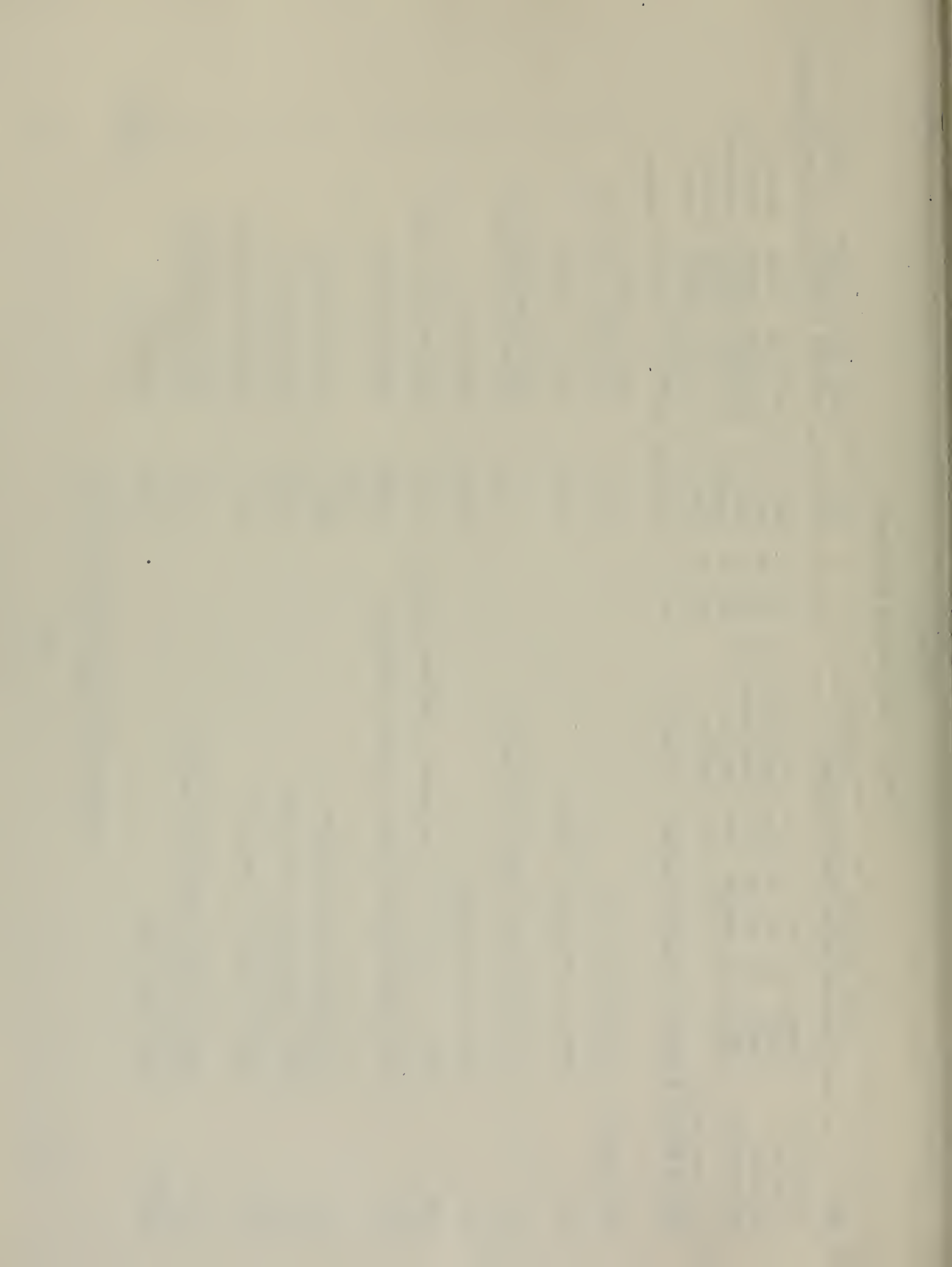


TABLE 13 - EXISTING WATERSHED PROJECT LIST

| Project No. | Type of Structures | Date of Completion | Legal Description | Total Cost | Total Yards | Maintenance Responsibility | Latest Inspection Report | Allotment Number | Original Funding |
|-------------|-------------------------------|--------------------|-------------------------|------------|-------------|----------------------------|---------------------------------|------------------|------------------|
| 0047 | Wolf Creek Reservoir | 8/25/38 | T4N, R99W, Sec 8 NENE | \$4,005 | 2,990 cy | Coop | 77 good | 6326 | 8100-4457 |
| 0239 | Winter Valley Reservoir | 11/15/37 | T4N, R99W, Sec 13 SWSW | \$2,027 | 3,100 | Coop | 77 good | 6326 | 8100-4457 |
| 0328 | Wolf Creek Reservoir #2 | 5/16/41 | T3N, R99W, Sec 4 NWSE | \$2,078 | ---- | Abandoned | 77 Piped through | | |
| 0677 | Coal Gulch Reservoir | 9/23/49 | T4N, R98W, Sec 30 SESE | \$160 | ---- | Coop | 77 breached | 6330 | 8100-4457 |
| 0716 | Upper Wolf Creek check dam #1 | 5/17/66 | T4N, R99W, Sec 8 SWSW | \$877 | 4,387 yd | | 77 holes in dam | 6326 | 4340-5257 |
| 0719 | #2 | 5/16/66 | T4N, R99W, Sec 17 NENW | \$674 | 3,374 | | | 6326 | 4340-5257 |
| 0722 | #3 | 5/9/66 | T4N, R99W, Sec 17 SWSW | \$1,783 | 9,694 | | 77 good | 6326 | 4340-5257 |
| 0725 | #4 | 5/13/66 | T4N, R99W, Sec 17 NESW | \$849 | 4,491 | | 77 good | 6326 | 4340-5257 |
| 0727 | #5 | 5/11/66 | T4N, R99W, Sec 17 SESE | \$856 | 4,697 | | 77 good | 6326 | 4340-5257 |
| 0730 | #6 | 4/29/66 | T4N, R99W, Sec 20 NNW | \$517 | 2,526 | | cleaned | 6326 | 4340-5257 |
| 0732 | #7 | 5/4/66 | T4N, R99W, Sec 19 NENE | \$1,176 | 6,640 | | | 6326 | 4340-5257 |
| 0735 | #8 | 5/2/66 | T4N, R99W, Sec 19 SENE | \$767 | 3,837 | | | 6326 | 4340-5257 |
| 0738 | Middle Fork Wolf Creek | | | | | | | | |
| 0740 | Check Dam #1 | 4/21/66 | T4N, R99W, Sec 20 NWNE | \$860 | 4,298 | | 77 good | 6326 | 4340-5257 |
| 0742 | #2 | 4/22/66 | T4N, R99W, Sec 20 NENW | \$481 | 2,403 | | 77 good | 6326 | 4340-5257 |
| 0742 | #4 | 4/28/66 | T4N, R99W, Sec 20 NWSW | \$565 | 2,826 | | 77 good | 6326 | 4340-5257 |
| 0776 | Baking Powder Reservoir | 7/24/51 | T4N, R99W, Sec 28 NENW | \$992 | | Coop | 73 good | 6331 | 4320-4457 |
| 0778 | Coal Gulch Reservoir #1 | 8/4/51 | T3N, R99W, Sec 12 SWSW | \$339 | | Abandoned | 77 good | 6333 | 4320-4457 |
| 0780 | #2 | 7/19/51 | T3N, R98W, Sec 6 SWNE | \$152 | | Abandoned | 77 good | 6330 | 4320-4457 |
| 0782 | #3 | 7/21/52 | T3N, R99W, Sec 23 NNW | \$157 | | Abandoned | 77 good | 6333 | 4320-4457 |
| 0784 | East Wagon Road Res. | 1951 | T4N, R99W, Sec 35, SESE | | | | No file listed in project plats | 6330 | 8100-4457 |
| 0821 | Peterson Draw Reservoir | 7/23/52 | T4N, R100W, Sec 23 NWSE | \$1,704 | 5,178 | Coop | 77 poor | 6323 | 4320-4457 |
| 0946 | North Coal Ridge Check Dam #1 | 11/5/67 | T3N, R100W, Sec 24 NWNE | \$1,127 | 6,076 | | 77 needs cleaning | 6324 | 4340-5257 |
| 0948 | #2 | 11/11/66 | T3N, R100W, Sec 24 NESW | \$520 | 2,514 | | 77 needs cleaning | 6324 | 4340-5257 |
| 0951 | #3 | 11/14/66 | T3N, R100W, Sec 24 NENE | \$697 | 3,712 | | 77 needs cleaning | 6324 | 4340-5257 |
| 0954 | #4 | 4/28/67 | T3N, R100W, Sec 24 NWSE | \$772 | 3,898 | | 77 needs cleaning | 6324 | 4340-5257 |
| 0957 | #5 | 4/17/67 | T3N, R100W, Sec 24 NENE | \$880 | 4,673 | | 77 needs cleaning | 6324 | 4340-5257 |
| 0959 | #6 | 11/30/66 | T3N, R99W, Sec 19 NWSW | \$852 | 4,372 | | 77 needs cleaning | 6324 | 4340-5257 |
| 0961 | #7 | 4/15/67 | T3N, R99W, Sec 19 NNW | \$1,269 | 6,909 | | 77 needs cleaning | 6324 | 4340-5257 |
| 0964 | #8 | 11/26/66 | T3N, R99W, Sec 19 SENW | \$976 | 4,630 | | 77 washed out | 6324 | 4340-5257 |
| 0968 | North Coal Ridge Check Dam #9 | 11/26/66 | T3N, R99W, Sec 19 NENE | 1,270 | 7,020 | | 76 lots of vegetation | 6332 | 4340-5257 |
| 0971 | North Coal Reef Retention Dam | 1966 | T3N, R99W, Sec 22 SWSE | | | Abandoned | No file listed in project plats | 6324 | 4320-4457 |

APPENDIX E

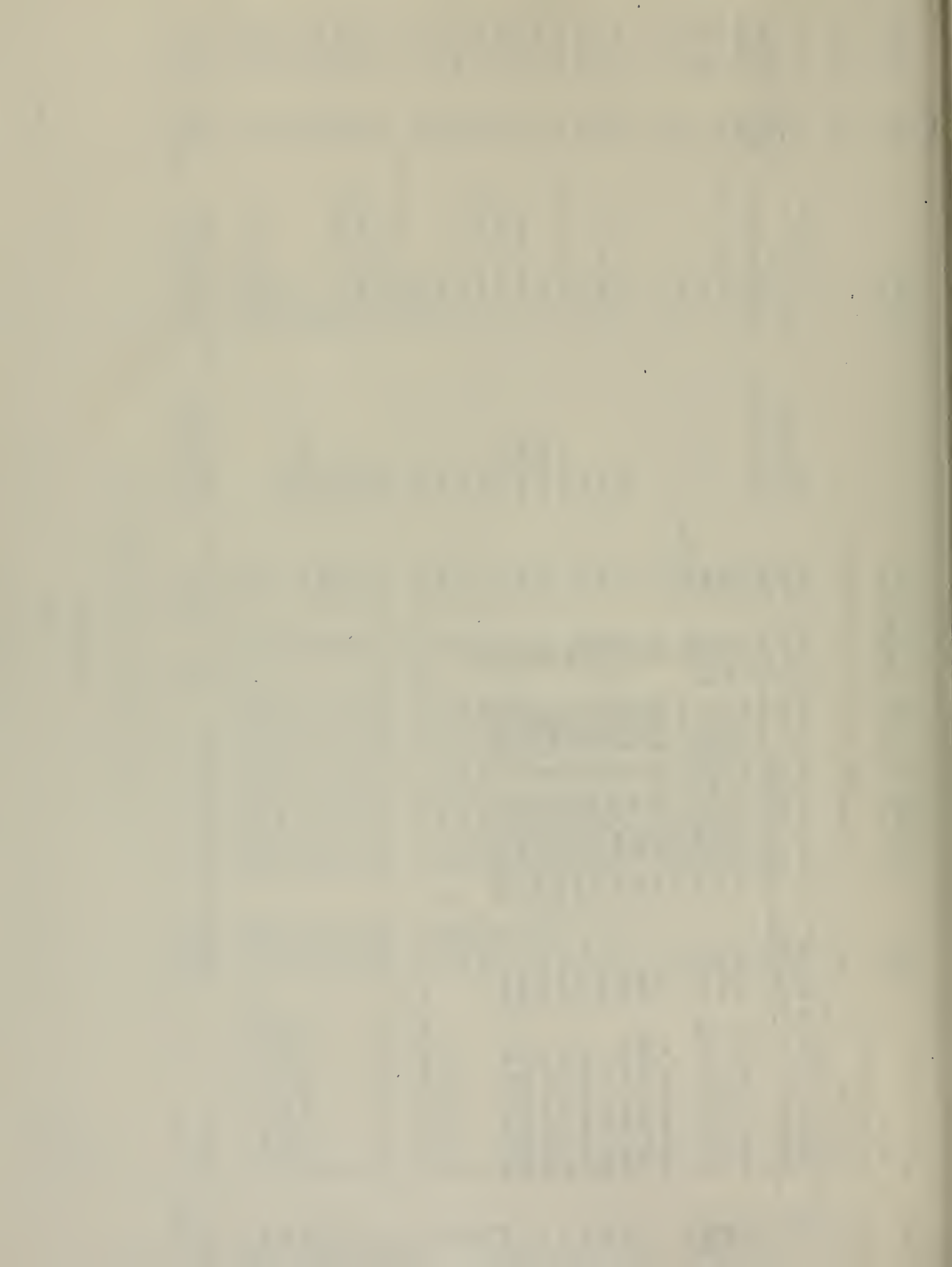
TABLE 13 - EXISTING WATERSHED PROJECT LIST

| Project No. | Type of Structures | Date of Completion | Legal Description | Total Cost | Total Yards | Maintenance Responsibility | Latest Inspection Report | Allotment Number | Original Funding |
|-------------|-----------------------------------|--------------------|-------------------------|------------|-------------|----------------------------|--------------------------|------------------|------------------|
| 0972 | Divide Crk Check Dam #1 | 11/25/66 | T3N, R99W, Sec 18 SE SW | 1,116 | 5,748 | | 77 good | 6324 | 4340-5257 |
| 0975 | Divide Crk Check Dam #2 | 11/19/66 | T3N, R99W, Sec 17 SWSW | 441 | 2,437 | | 83 needs cleaning | 6332 | 4340-5257 |
| 1057 | Wagon Ridge Reservoir | 5/31/57 | T4N, R99W, Sec 27 SWSE | 120 | | Coop | 65 good | 6330 | 4320-4457 |
| 1103 | Mancos Reservoir #1 | 10-26-57 | T4N, R99W, Sec 7 SWSE | 1,638 | 9,659 | Abandoned | None | 6326 | 4320-4457 |
| 1106 | #2 | 11/6/57 | T4N, R99W, Sec 7 NWSW | 928 | 5,480 | Coop | None | 6326 | 4320-4457 |
| 1107 | #3 | 11/6/57 | T4N, R100W, Sec 13 NENE | 628 | 3,128 | Coop | 77 needs cleaning | 6323 | 4320-4457 |
| 1109 | #4 | 12/3/57 | T4N, R100W, Sec 25 NESW | 413 | 2,425 | Coop | 77 needs cleaning | 6323 | 4320-4457 |
| 1111 | Peterson Draw Res. #2 | 5/13/68 | T4N, R100W, Sec 24 SENE | 2,471 | 10,317 | Coop | 77 washed out; | 6323 | 4320-4457 |
| 1151 | Divide Crk Detention Dam | 10/2/58 | T3N, R100W, Sec 13 SW | 20,560 | 36,000 | 4350 | 11/22/77 reconstructed | 6324 | 4340-5257 |
| 1165 | Divide Crk Res. #2 | 10/4/58 | T3N, R99W, Sec 20 SWNW | 513 | 3,019 | Coop | 83 good | 6334 | 4320-4457 |
| 1167 | #3 | 10/4/58 | T3N, R99W, Sec 21 SWNW | 481 | 2,830 | Coop | 76 good | 6334 | 4320-4457 |
| 1169 | #4 | 10/16/58 | T3N, R99W, Sec 21 SENW | 445 | 2,617 | Coop | 76 needs cleaning | 6334 | 4320-4457 |
| 1170 | #5 | 10/6/58 | T3N, R100W, Sec 24 NENE | 523 | 3,075 | Abandoned | 77 needs cleaning | 6334 | 4320-4457 |
| 1172 | Lower Wolf Crk Res. #1 | 10/23/58 | T3N, R99W, Sec 18 NWNE | 316 | 1,857 | Abandoned | 77 needs cleaning | 6324 | 4320-4457 |
| 1174 | #2 | 10/27/58 | T3N, R99W, Sec 7 SWSW | 664 | 3,906 | Abandoned | 77 needs repair | 6332 | 4320-4457 |
| 1176 | #3 | 10/58 | T3N, R99W, Sec 17 NWSW | | | Abandoned | 77 good | 6332 | 4320-4457 |
| 4081 | Elk Springs Res. #1 | 11/69 | T4N, R99W, Sec 10 NW | 100 | 450 | Abandoned | 77 spillway eroding | 6332 | 4320-4457 |
| 4082 | #2 | 11/69 | T4N, R99W, Sec 10 NESE | 100 | 457 | Coop | 77 good | 6326 | 8100-4457 |
| 4083 | #3 | 11/69 | T4N, R99W, Sec 14 NESE | 80 | 389 | Coop | 77 good no file | 6326 | 8100-4457 |
| 4096 | Lower Winter Valley Check Dam #1 | 6/71 | T3N, R99W, Sec 12 SENW | 948 | 4,010 | | 77 good | 6326 | 8100-4457 |
| 4219 | #2 | 6/71 | T3N, R99W, Sec 12 NENW | 993 | 4,262 | | 76 good | 6333 | 4340-5257 |
| 4220 | #3 | 6/71 | T3N, R99W, Sec 12 NENW | 930 | 3,910 | | 77 good | 6333 | 4340-5257 |
| 4221 | #4 | 6/71 | T3N, R99W, Sec 12 NENW | 1,327 | 6,131 | | 77 good | 6333 | 4340-5257 |
| 4222 | #5 | 6/77 | T3N, R99W, Sec 12 SWNW | 890 | 3,689 | | 77 poor piped through | 6333 | 4340-5257 |
| 4223 | #6 | 6/77 | T3N, R99W, Sec 11 NESE | 1,307 | 6,019 | | 77 good | 6333 | 4340-5257 |
| 4319 | Winter County Check Dam | 12/81 | T4N, R100W, Sec 11 SWSW | 2,700 | 2,137 | | 77 good | 6333 | 4340-5257 |
| 4255 | Sheep Trail Reservoir | 4/72 | T4N, R99W, Sec 21 NWNW | 1,320 | 5,643 | Coop | Good | 6323 | 4340-5257 |
| 4554 | Middle Fork Wolf Creek Saline Dam | 1976 | T4N, R99W, Sec 19 SESE | 5,300 | 2,939 | Coop | 77 poor breached | 6331 | 8100-4457 |
| 4555 | Wolf Creek Diversion Dam #1 | 1976 | T4N, R99W, Sec 19 NESE | 6,000 | 3,000 | | 77 good | 6326 | 4340-5257 |
| 4556 | #2 | 1976 | T4N, R99W, Sec 19 NESE | | 1,127 | | 77 good | 6326 | 4340-5257 |

APPENDIX E

TABLE 13 - EXISTING WATERSHED PROJECT LIST

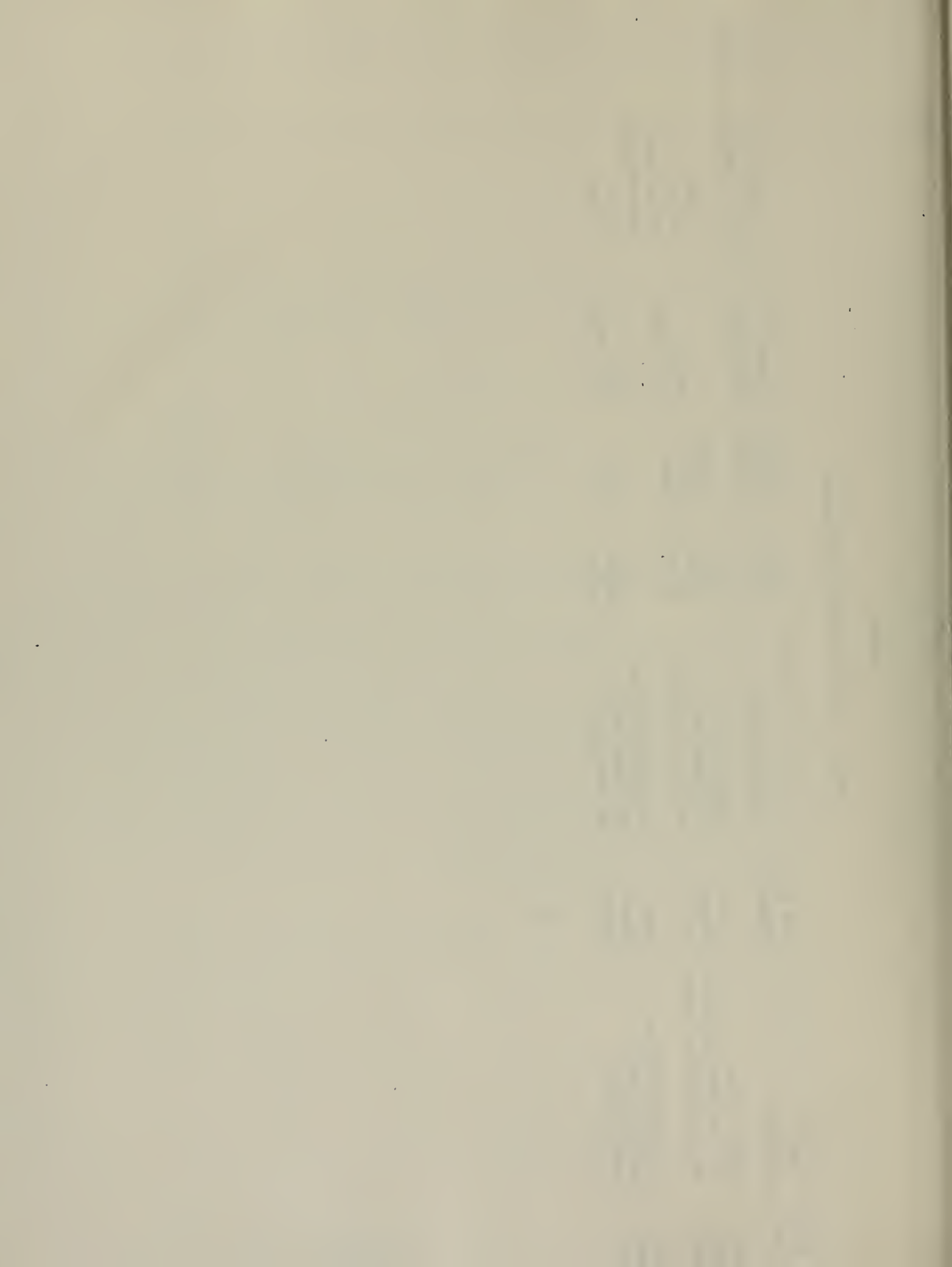
| Project No. | Type of Structures | Date of Completion | Legal Description | Total Cost | Total Yards | Maintenance Responsibility | Latest Inspection Report | Allotment Number | Original Funding |
|-------------|----------------------|--------------------|---------------------------|------------|-------------|----------------------------|--------------------------|------------------|------------------|
| 1557 | Water Gap Reservoir | 9/1983 | T3N, R100W, Sec 23 SESE | \$4,900 | 6,363 | | | | |
| 1558 | Water Gap Pit | 9/1983 | T3N, R100W, Sec 24 SWNW | \$1,000 | 900 | | | | 4340-5257 |
| 1559 | Salinity Gully Plugs | 9/1983 | T3N, R100W, Sec 23 SE | \$500 | 121 plugs | | | | |
| | | | Sec 24 W1/2 | | | | | | |
| | High Dobie Pit #1 | 9/84 | T3N, R99W, Sec. 4, NENESW | 980 | | | | | |
| | High Dobie Pit #2 | 9/84 | T3N, R99W, Sec. 4, SESWNW | 980 | | | | | |
| | High Dobie Pit #3 | 9/84 | T3N, R99W, Sec. 4, SMSWNW | 2,285 | | | | | |
| | High Dobie Pit #4 | 9/84 | T3N, R99W, Sec. 5, SENESE | 3,390 | | | | | |
| | High Dobie Pit #5 | 9/84 | T3N, R99W, Sec. 4, SWNWSW | 980 | | | | | |
| | High Dobie Pit #6 | 9/84 | T3N, R99W, Sec. 9, NNNWNW | 980 | | | | | |
| | High Dobie Pit #7 | 9/84 | T3N, R99W, Sec. 9, SWNWNW | 980 | | | | | |
| | High Dobie Pit #8 | 9/84 | T3N, R99W, Sec. 9, NNNENW | 1,400 | | | | | |
| | High Dobie Pit #9 | 9/84 | T3N, R99W, Sec. 9, NENENW | 1,190 | | | | | |



APPENDIX F

TABLE 14 - EXISTING VEGETATION MANIPULATION

| Project No. | Type of Structure | Date of Completion | Legal Description | Total Cost | Cost/yd. of mile | Method of Construction | Inspection Report Information | Allotment |
|-------------|-----------------------------|--------------------|-----------------------|------------|------------------|------------------------|-------------------------------|-----------|
| 684 | Mancos Furrows | 6/3/66 | T3,4N, R99,100W | \$5,731 | \$7.85/ac | | 77 Good | |
| 754 | M.F. Wolf Creek Gully Plugs | 6/25/66 | T4N, R99W, Sec 19 | \$3,125 | \$17/hr | D-8 Cat | 77 Fair | |
| 823 | Peterson Draw Brush Removal | 8/30/54 | T4N, R100W, Sec 23 NE | \$2,338 | \$39/ac | 60 ac seeded | 77 Poor fence down overgrazed | |
| 978 | Skull Creek Check Dam | 6/1/67 | T3N, R100W, Sec 13 NW | \$473 | | Dozer | 77 Fair | |
| 1008 | Coal Ridge Dikes | 4/29/56 | T3N, R100W, Sec 15 | \$10,541 | \$11/hr | D-8 & Scraper | 77 Poor | |
| 1075 | Mancos Spreaders | 5/19/66 | T4N, R99W, Sec 7 | \$2,311 | | | | |



APPENDIX G
RANGE SITE DESCRIPTIONS

TABLE 15 - RANGE SITES OCCURRING IN THE LOWER WOLF CREEK WATERSHED
(Alphabetical Listing)

| | | <u>Treatment Units</u> |
|------------|------------------------|----------------------------|
| 297 | Alkaline Slopes | 2 |
| 289 | Clayey Foothills | 1 |
| 403 | Clayey Saltdesert | 1 |
| 246 | Clayey Slopes | 1 |
| 292 | Deep Loam | 4 |
| 235 | Dry Exposure | 5 |
| 231 | Dry Mountain Loam | 4 |
| 285 | Foothills Swale | 2 |
| Moffat | Gravelly 7 - 14 Inches | 4 |
| 100 or 109 | Juniper Woodland | 5 |
| Moffat | Loamy 10 - 14 Inches | 4 |
| 300 | Loamy Breaks | 4 |
| 401 | Loamy Saltdesert | 1 |
| 228 | Mountain Loam | 4 |
| 298 | Rolling Loam | 4 |
| 406 | Saltdesert Breaks | 1 |
| 407 | Saltdesert Over Flow | 2 |
| 293 | Sandhills | 4 |
| 310 | Sandy Foothills | 4 |
| 402 | Sandy Saltdesert | 1 |
| Moffat | Semi-desert Clay Loam | 1 |
| Moffat | Semi-desert Loam | 1 |
| Moffat | Semi-desert Sandy Loam | 4 |
| 287 | Stony Foothills | 5 |

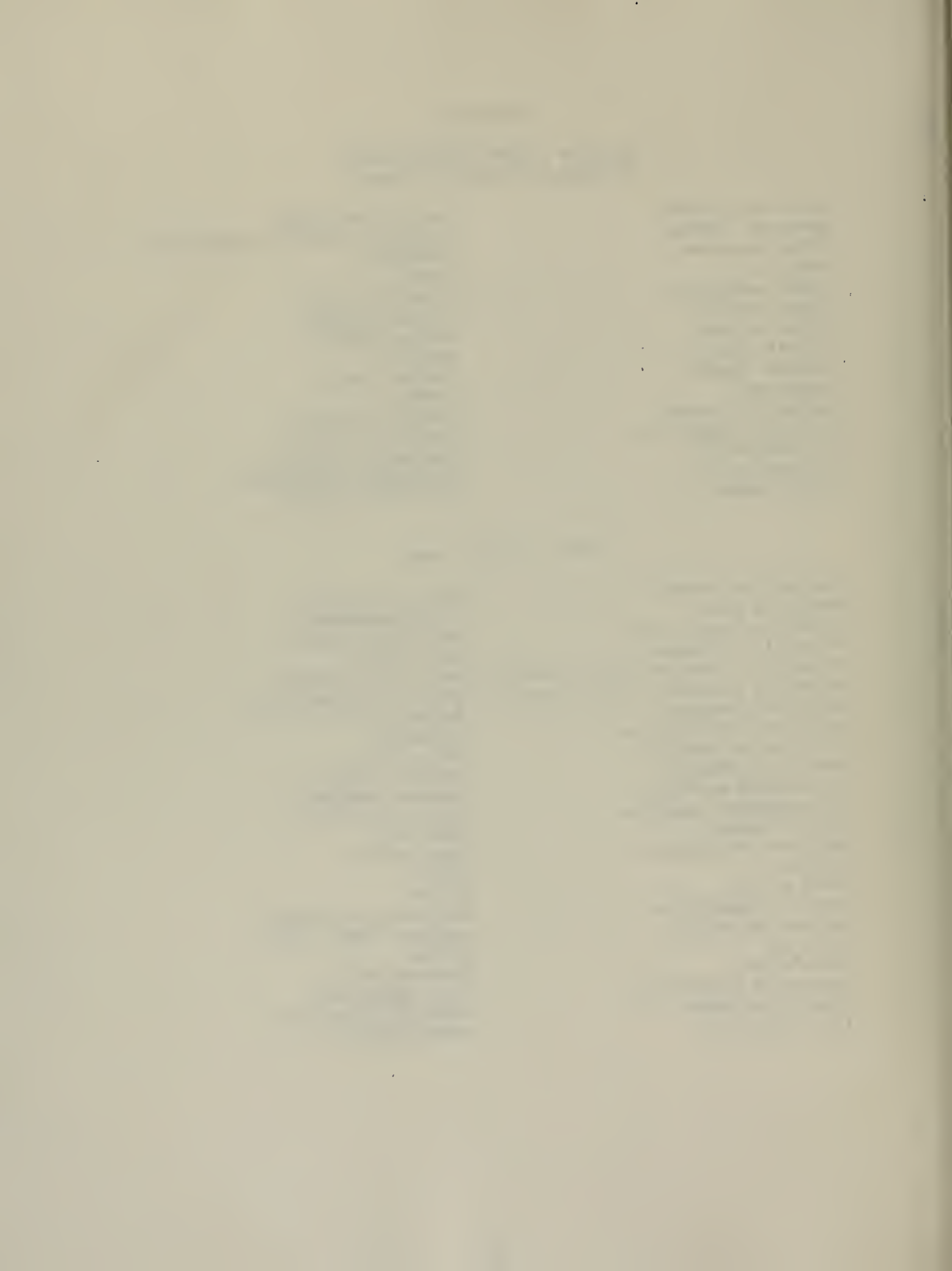
APPENDIX H

TABLE 16 - PLANT SPECIES NAMES
Grasses and Grasslike Plants

| | |
|----------------------|--------------------------------|
| Agropyron smithii | western wheatgrass |
| Agropyron inerme | beardless bluebunch wheatgrass |
| Bromus tectorum | cheatgrass |
| Carex spp | sedges |
| Elymus ambiguous | Colorado wildrye |
| Elymus junceus | Russian wildrye |
| Elymus salinus | salina wildrye |
| Hilaria jamesii | galleta |
| Hordeum jubatum | foxtail barley |
| Juncus spp | rushes |
| Koeleria cristata | prairie junegrass |
| Oryzopsis hymenoides | Indian ricegrass |
| Poa sandbergii | Sandberg's bluegrass |
| Sitanion hystrix | bottlebrush squirreltail |
| Stipa commata | needle-and-thread |

Forbs, Shrubs, Trees

| | |
|--------------------------------------|------------------------|
| Amelanchier utahensis | Utah serviceberry |
| Artemisia cana | silver sagebrush |
| Artemisia ludoviciana | Louisiana sagewort |
| Artemisia spinescens | bud sagebrush |
| Artemisia tridentata var. tridentata | basin big sagebrush |
| Artemisia tridentata var. vaseyana | mountain big sagebrush |
| Atriplex canescens | fourwing saltbush |
| Atriplex confertifolia | shadscale |
| Atriplex corrugata | mat saltbush |
| Atriplex gardnerii | gardners saltbush |
| Cercocarpus montanus | mountain mahogany |
| Chrysothamnus nauseosus | rubber rabbitbrush |
| Eurotia lanata | winterfat |
| Juniperus osteosperma | Utah juniper |
| Lupinus | lupine |
| Pinus edulis | pinyon |
| Populus angustifolia | narrowleaf cottonwood |
| Purshia tridentata | antelope bitterbrush |
| Salix spp | willow |
| Salsola kali | Russian thistle |
| Sarcobatus vermiculatus | black greasewood |
| Tamarix pentandra | saltcedar, tamarisk |
| Typha latifolia | common cattail |



APPENDIX I

TYPES OF STRUCTURES, VEGETATION MANIPULATIONS AND MANAGEMENT SYSTEMS

The following material is intended to provide guidance in the selection and evaluation of measures for erosion and sediment reduction. The choice of a particular measure would be based on a study of detailed site characteristics and a determination of maximum cost-effectiveness.

1. Vegetation Management and Land Treatment Measures

Tree and Shrub Planting - Tree or shrub seedlings or cuttings would be planted to establish desirable cover. Cottonwood, willows, Chinese elms, and other adapted woody plants (excepting tamarisk) would be planted along channels where perennial water could be found in the alluvium. Deep roots would improve channel stability and enhance sedimentation by hindering bank cutting. Improved riparian cover would enhance wildlife habitat.

Brush Control - Pinyon-juniper, sage, and brush would be eradicated and replaced with more desirable vegetation. In level areas where machinery can operate, thick overgrown brush should be removed by mechanical or chemical means to allow desirable grasses and forbs to provide ground cover, thereby reducing rain splash and sheet erosion and improving infiltration. Wind exposed sites should be avoided because snow pack redistribution and wind erosion would reduce effective precipitation. Alluvial terraces may be the most desirable sites; however, greasewood and sodium near the surface may require supplemental treatments.

Critical Area Planting - Severely eroded areas would be stabilized by establishing vegetation cover. Rapid growing adapted species could be planted to provide a quick protective vegetation cover in areas where accelerated erosion could occur. Surface disturbances in spillways, grassed water ways, and other areas conveying water could be drill seeded, fertilized, and mulched for quick reestablishment of vegetation cover.

Range Seeding - Adapted plants would be established by seeding. Large areas lacking adequate vegetation would be seeded with adapted species. Areas having brush control, contour furrowing or chisel plowing would be seeded. Deferment for a minimum of two growing seasons would be required for seedling establishment.

Chiseling and Subsoiling - The soil would be loosened, without inversion and with a minimum of mixing of the surface soil, to shatter restrictive layers below the normal plow depth that inhibit water movement or root development.

Contour Furrowing - Furrows would be plowed on the contour at intervals which would vary with precipitation, slope, soil, and cover. This should be done in areas of poor or undesirable vegetation where machinery can operate and where improved infiltration is needed. Furrowing would be accompanied by reseeding.

Grassed Waterways - Water would be taken out of a gully by changing the topography and lining the new channel with protective vegetation. In waterways, flow can be modified in two ways: (1) lengthen the water course to provide a gentler bed gradient and (2) widen the cross section of flow to provide more gentle channel side slopes.

Requirements for a successful grassed water way are: (1) quick establishment of rhizominous vegetation, (2) gullies not larger than the volume of material excavated for the channel, (3) valley bottom width large enough for additional length of new meandering waterways, (4) soil depth adequate for reshaping topography, (5) depth of topsoil sufficient for subsequent spreading on all disturbed areas, and (6) an intensive inspection and maintenance program.

Controlled Burn - Similar to brush control, however, the method of using prescribed burns favors different plant reestablishment. This can be used in rougher terrain and is often less expensive than mechanical or chemical methods; however may require reseeding. Conditions must be favorable and not all vegetation communities can be burned. Either planned ignitions and prescribed fire can be used and are described below:

- a. Planned Ignitions. Most prescribed fires will start from planned ignitions. Planned ignitions allow easier coordination of weather, fuel moisture, soil moisture, fire loads, and other parameters with the time of ignition. Adequate personnel for burning, containment, protecting desirable features (snags, cultural resources, wildlife and trees), and preventing escape are more readily available on a planned basis. Control lines, where required, and other containment measures can be prepared in advance. Often where mixed ownerships are affected, cooperative agreements can be executed allowing containment at a ridge top, road, creek bottom or there logical control point rather than at an undesirable located property boundary.
- b. Prescribed Fire. Prescribed fire is a fire burning under specified conditions which will accomplish planned objectives in strict compliance with an approved plan. Although ignition may be either planned or unplanned, the conditions under which burning takes place and the expected results are specific, predictable, and measureable. The objectives of prescribed fire are for vegetation manipulation, control of insects and disease, hazardous fuel reduction and the disposal of combustible residues.

Proper Grazing Use - Grazing would be managed at an intensity which would maintain adequate cover for soil and maintain or improve the quantity and the quality of desirable vegetation.

Rotation - Deferred Grazing - Grazing would be managed under a system where one or more grazing units are rested at planned intervals throughout the growing season of key plants, with no unit being grazed at the same time in successive years.

Livestock Exclusion - Livestock would be excluded from any area where grazing is harmful or otherwise undesirable.

Trespass Control - Unauthorized uses detrimental to the land would be prevented.

2. Structural Measures

Reservoirs - Permanent storage of sediment and either temporary or permanent water storage would be provided for. Reservoirs and Dams are classified as (a) retention, (b) detention dam, or (c) pit reservoirs, and (d) earth check dams which are explained below. They are usually located on main channels of small watersheds (less than 10 square miles). The sites need to be free of large rock fragments and shallow bedrock and accessible by heavy equipment.

- a. Retention Dam. These structures retain watershed runoff. The small retention dam reservoirs and "stock ponds" provide an inexpensive source of water for livestock and wildlife. They usually have no outlets other than emergency spillways.
- b. Detention Dam. Detention dams store little water except for the volume retained for sedimentation storage. They are designed to control a certain design storm without the use of the emergency spillway. Detention structures are used where there is a need to control runoff, reduce peak flows to protect downstream development, and stabilize the downstream channel by dissipating the water's energy. They are also used to control flood water that is diverted into water spreading systems. Reservoirs would be fenced where needed on a site-specific basis.
- c. Pit Reservoirs - These are excavations that are usually off channel and located on slopes less than 5 percent. The soils should be deep, fine textured and generally free of rock. Pit reservoirs should be located away from gullies and head cuts. The excavated fill material that forms the berm at the lower end of the pit doesn't retain water itself; thus no emergency spillway is required. The purpose of pit reservoirs is to intercept runoff and act as a sediment trap.
- d. Earth Check Dams - These structures are small earth dams, usually less than 15 feet at the highest point, and are often not keyed into channel banks. They are not designed to store water and function mostly as a sediment trap. In small watersheds, they will intercept some runoff and reduce local flooding. They are often used in a series or in conjunction with other structures.

Gully Plugs - Water infiltration and runoff retention would be improved by making a multitude of small pits and berms in the headwaters of a gully system. These small structures are made with a bulldozer working down a drainage from the divide. Small pits (less than 5 feet deep) very close to each other (100-300 feet apart) are excavated. Critical area planting should be done in conjunction with this treatment.

Contour Terracing - Water storage would be developed along the contour by excavation and soil would be placed as an embankment along the downslope side. Intervals would vary with the precipitation, slope and soil.

Diversions and Dikes - Devices would be used to divert water away from eroding areas. These are not used very frequently due to additional problems resulting from concentrating the flow of surface runoff.

Porous Check-Dams - Small dams would be built of loose rock or rock reinforced by wire mesh, steel posts, or other material. Porous dams release part of the flow through the structure and decrease the flow over the spillway and the dynamic and hydrostatic forces against the dam. Design and site characteristics are less critical; however, hard cobble size rock is needed in abundance along with access for machinery.

Drop Structures - Concrete, masonry, sheet piling, or earth structures would be placed in eroded channels below the top of the bank to control grade, prevent further erosion, and provide sediment storage. This structure would allow channels to reach a lower base level while absorbing the energy from the falling water.

Revetments - Materials would be anchored on the stream bank to protect it from erosion by stream flow. For example, cut juniper could be trees anchored to fence posts. Offensive material such as old car bodies should not be used.

Sills - Structures of rock, masonry, rails, etc., would be placed on a channel grade to prevent stream downcutting. Sills may be used with grassed waterways with good results.

Channel Lining - Channel bottoms and banks would be protected with concrete or riprap.

Jacks and Jetties - Projections would be built in a stream channel to divert currents away from a vulnerable bank. The best use of these treatments is for protection of an existing structure or building, but extensive hydraulic analysis should be done to prevent new problems downstream.

Disturbed Area Protection - This measure could include any of the above treatments and structures in a small area. A site plan would detail intensive management for critical areas. In addition, it often includes stabilizing steep slopes, lining road ditches, building fenced exclosures, protecting critical spillway sites, etc.

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